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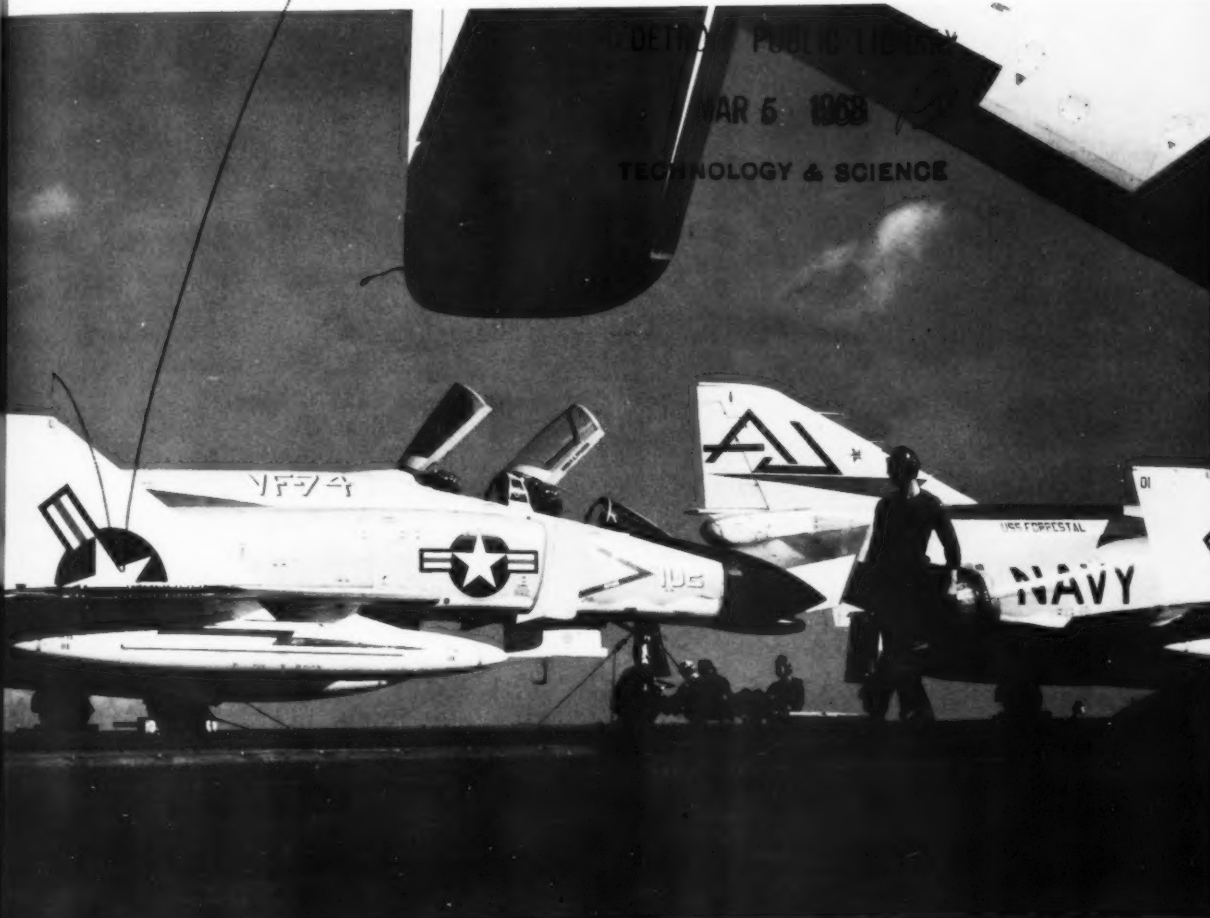
THE NAVAL AVIATION SAFETY REVIEW



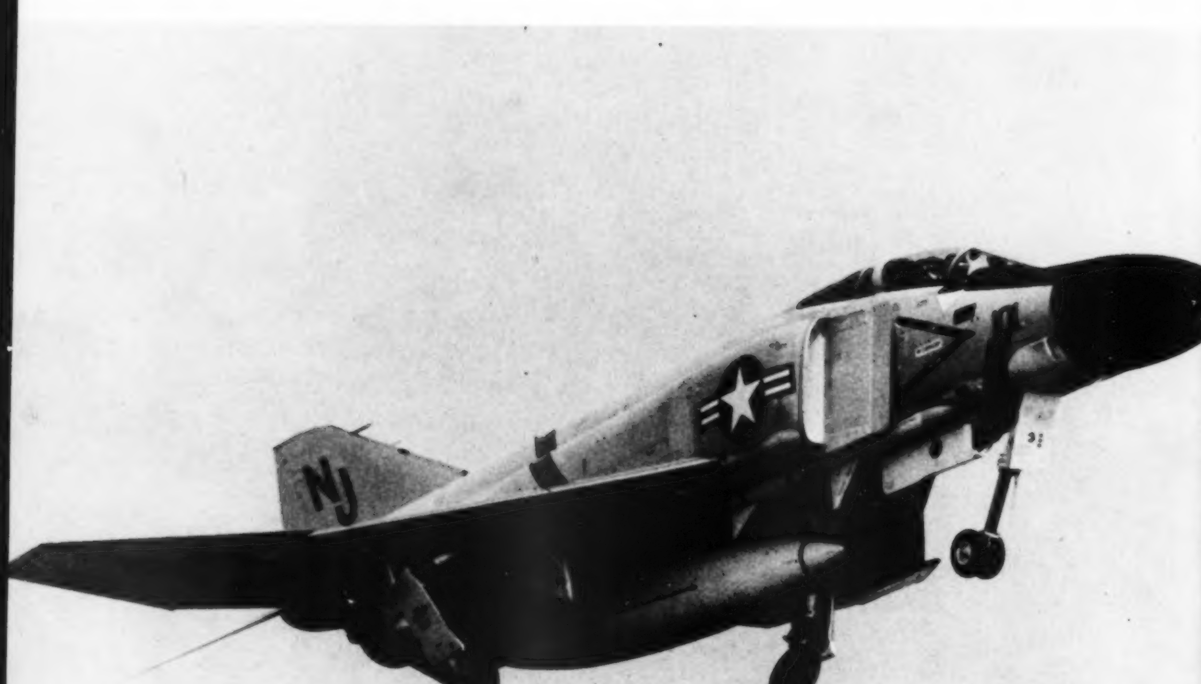
MARCH 1963

NATOPS Stimulate Cockpit Headwork?

Preventing Bridle Shedding

G-Suit—That Extra Margin

Finding Fuel Leaks



MAX ⟶ PERFORMANCE TAKEOFFS

a most dangerous phase of flight!

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by Don Stuck

Experimental Test Pilot
McDonnell Aircraft Co.

The tired old joke "it wasn't the fall that killed him it was the sudden stop" is not without truth. This philosophy helps explain why our most critical phases of flight are takeoff and landing. Our margin for error is less since we are closer to something to hit—namely, the ground, ship or water.

We, as pilots, help to compound this already unfavorable situation by our own inputs. Although we don't inherently make any more mistakes in the landing or takeoff phases of flight, we do get caught easier, and also, being so close to our viewing public tends to increase our grandstanding desires a little more than when no one's watching.

I personally feel that this grandstanding desire is normal, however, there is no place in the ranks of professional pilots for a show-off—who doesn't know what he's doing.

With a new aircraft such as the F-4B there are many times when pilots are asked to demonstrate the aircraft. There have been lots of articles in the past on why you shouldn't grandstand and they are all 100 percent correct but I'd like to direct this one toward the pilot who is directed to put on an informal show during the course of a normal mission. If you don't do the job properly, you won't show off your talents or the machine to best advantage, and if you over-extend yourself, you have a better than average chance of chalking up an accident or even killing yourself.

I will use the F-4B as the example aircraft; however, the basic principles apply to any and all fighter aircraft—only the numbers change.

In my mind there are three considerations which should dictate the type show you put on:

1. Aircraft limitations including its performance under the ambient and gross weight conditions which are prevalent.
2. Pilot limitation—don't be proud, you are only analyzing your abilities with yourself.
3. Audience technical intelligence level.

Of the phases of flight which lend themselves to grandstanding, the takeoff phase is probably the most abused.

Takeoffs become impressive by ground roll, acceleration and post takeoff attitude and performance. All of this boils down to excess thrust.

The excess thrust available is primarily affected by three parameters. Two are quite apparent and the third possibly obscure. The apparent ones are, of course, drag and basic weight of the aircraft. The third is speed. Both drag and thrust are affected by speed. The drag picture changes from high at very low speeds to low at some intermediate speed and back to high at very high speeds. The gross thrust of the aircraft becomes higher with speed throughout this same speed envelope. From this it is apparent that the maximum *excess* thrust occurs at some intermediate speed where drag is low but gross thrust has been given a chance to develop. This is the region where most attempted demonstrations of takeoff performance fall flat on their face—in some cases literally. The novice pilot, feeling a goodly amount of excess thrust during the takeoff roll, forces the aircraft off the ground in an extreme attitude (high-angle-of-attack) and then immediately tries to climb, thereby strangling any hope of developing some real high values of excess thrust.

The sad part is that the difference in time and ground roll between a forced lift-off and optimum is for all practical purposes undetectable to an observer. Also, the couple of seconds spent after lift-off in accelerating to optimum pull-up speed rather than climbing immediately pays off in high and more impressive pitch attitudes and, even more important, climb instead of mush.

Most important in the forced takeoff and premature attempt to climb is the safety aspect. Although crashes, fire, blood and gore are great crowd pleasers, I'm sure that this type of impromptu entertainment is not what you have in mind.

A widely publicized bit of film in flight safety circles shows the XB-51 in an attempted short-field takeoff. In this case *excess* thrust was marginal to begin with and premature rotation and pull-off produced sufficient induced drag to cancel out excess thrust. With no excess thrust the aircraft couldn't accelerate and without acceleration it couldn't develop any excess thrust, so there it sat, gear retracted, on the back side of the power curve with the narrow margin of increased lift due to ground effect the only thing holding it up. Trying to fly under these conditions is like trying to balance a ball bearing on a needle point, so naturally the aircraft finally went up in a ball of fire.

This lack of basic thrust doesn't particularly plague us any more with aircraft like the F-4B but the

same principles still exist in allowing speed to develop so that we can achieve max excess thrust for the prevailing conditions. In addition, don't think for a minute that you can't find some combination of high gross weight and unfavorable ambient conditions for the F-4B that will put you awfully close to the thrust/weight ratio of that XB-51.

The other extreme of this story is so much raw excess thrust that the aircraft enjoys the enviable position of having close to or better than 1 to 1 thrust/weight ratio. The F-4B, I'm pleased to say, falls in this category. Here a premature and extreme rotation will convert part of the thrust vector to a strong vertical component and under favorable thrust/weight conditions can launch the aircraft (Atlas style) before you're ready and, worse yet, before the aircraft is above stall speed. Once again the results are pretty obvious.

Present day fighters can exhibit some pretty good crowd pleasing demonstrations if they are handled properly. Properly means a technique that is tailored to the aircraft's attributes.

The aircraft should leave the ground at the same attitude regardless of weight, temperature or field elevation. The manual does not spell out a special technique for short field operation for good reason—there is none! The basic takeoff performance is already very good and it must be understood that the objective does not end with just getting the aircraft off the ground—it has to fly also! The price you pay in poor post-takeoff performance and hazard potential by trying to beat optimum ground roll by a couple of hundred feet just "ain't worth it"! If you want to shorten takeoff roll for airshow purposes there are two variables you can adjust—arrange your flight around favorable ambient conditions and/or adjust gross weight at takeoff to obtain a more desirable thrust/weight ratio.

There is only one way that the F-4B takeoff ground roll can be changed after the aircraft is committed to a gross weight and a set of ambient conditions. If an A/B takeoff is made with normal takeoff flap position, some amount of thrust degradation is accepted to provide BLC. In addition, the flaps represent some very small amount of drag during takeoff roll. Therefore, if the flaps are left up until they are actually needed (started down about 90 KIAS), the added thrust and reduced drag during the initial portion of the takeoff roll will reduce the takeoff roll possibly as much as 100 feet. Big deal, huh? If you can conceivably think it's worth the trouble, be my guest, but for my money there is *no* method for tactical application which can provide any significant improvement over the *properly executed* handbook takeoff technique. To the observing crowd, post takeoff performance is part of the show, whether you like it or not; therefore it must be taken into consideration in planning any takeoff demonstration. After the aircraft breaks ground, it can only do one of three things to impress a crowd.

1. Crash

2. Maneuver close to the ground to include acrobatics and low speed flight

3. Climb

Don't laugh at No. 1. If your show is not planned and executed properly, you stand a better than average chance of "dinging" right there. Number 2 is demanding, should be well practiced beforehand with adequate safety margins and the end result should be worth the effort since the risk potential is high. It would appear that the greatest cause for concern here centers around the fact that you might be operating the aircraft close to its stall margin. Configuration change techniques during the demo might be different than normal. If you're laying on the flaps (or BLC), don't snatch them up without adequate speed or acceleration to see you through the transition. I recognize that this advice sounds pretty unnecessary since no one intentionally pulls flaps out from underneath him but habit pattern can get into the act here, so watch your step. I can vividly recall an experienced pilot making a low speed fly-by in a B-57 with gear and flaps down. His run was stable at a few knots above stall at about 200 feet. When he had passed the crowd his intent was to clean up and accelerate; however, habit pattern caught him and he raised the flaps automatically as soon as he started the gear up. Without enough altitude or excess thrust available to gain speed he tried to keep from mushing into the ground and spun in. Practice the exact technique you are going to use.

Number 3 is where the F-4B can really make you some points in demonstrations. A well executed takeoff and climb demonstration with this much performance is impressive to an audience of any technical level and shows the weapons system and pilot to good advantage.

Basically any takeoff-and-climb demonstration for the F-4B should be done from a clean (no-flap) takeoff, since the only thing you lose out on is a couple of hundred feet of takeoff roll which will probably not even be noticed by the crowd. The no-flap takeoff results in better accelerations, earlier pull in to climb, higher climb angles and better altitudes in any given

time slice.

The critical factor is allowing the aircraft to develop excess thrust. It is obvious that you can't climb without pointing up and it is also obvious that you can't climb after you are pointed up if you have no forward speed so the best trade-off or cross-over point is what we're looking for.

The areas where you make or strangle the demonstration are:

Takeoff—Allow the aircraft to fly off at normal pitch attitude of approximately five degrees. If you force the lift-off, you will be at high pitch and angle of attack values which produce higher than desired drag and a greater pitch transition to level flight for acceleration.

Acceleration—The aircraft must be allowed to accelerate to some speed before applying load factors to increase pitch. This optimum speed value is determined by gross weight, ambient conditions, G-rate and G-value for pull-up, desired climb angle, max altitude desired and aircraft flight parameters desired when arriving at the desired altitude.

One basic rule applies to acceleration—if you are going to be in error on pull-up speed, make sure it's on the "too fast" side.

Too slow means you'll never develop the thrust necessary to do the job. Too fast means you've used a little time in getting too fast, but you can convert most of it back by the fact that the majority of your forward velocity is climb once you establish pitch angle. A good general minimum pull-up speed is 275 knots regardless of how light your gross weight or how good your ambient conditions. If you're heavier, or it's warmer than normal, this speed must be adjusted to a higher value. For the production aircraft never initiate the pull-up below 275 KIAS.

G-Loading—This includes aim G and the rate which is used to arrive at it. The optimum values, here again, depend on airplane weight, ambient conditions, climb angle and max altitude desired. In addition, they depend on the speed at which you start the pull-up. The higher the speed for initiating pull-up the higher the excess thrust to combat induced drag of the pull-in while still allowing the aircraft to accelerate. Again, if you are going to make an error, make it on the low side for both rate and aim G. This technique will result in a slight time loss due to acquiring excessive speed which is again converted back to your advantage once climb angle is established. A good general rule is ½G/sec. rate with 2-½G being maximum aim G.

Climb Angle—Generally speaking, climb angle desired is dependent mainly on speed and aim altitude. Without qualification it can be said that there will be no condition where an excess of 60 degrees pitch attitude will work to your advantage. Once again be on the low side if you are going to be in error. Your forward acceleration is still in the up direction. If you get too steep, you are not only inefficient, you can also be faced with an aircraft recovery problem. For the production aircraft a pitch angle of over 50 degrees is very seldom desirable. The big thing to keep in mind here is that at 30 degrees of climb angle you are converting 50 percent of forward speed to climb. At 50 degrees of climb angle you are converting 75 percent of your forward speed to climb and at 60 degrees you're only converting 10 percent more of your forward velocity to climb. Now it gets down to how much forward velocity does it cost you to get to and hold a higher pitch angle. You can easily see you have a better rate of climb at 400 knots at 50 degrees than 350 knots at 60 degrees of climb. In addition, the airspeed bleed-off will naturally be more severe at the higher pitch angles which even compounds the problem. *Don't overrotate.*

Aim Altitude and Aircraft Recovery—The planning for your attempt must start with the altitude you are striving for and the condition you want to arrive there. It is obvious if you are going to use up all your energy to get to some low altitude, there's no chance of getting higher. Also, if you are aiming for a higher altitude, your time to the lower altitude will be somewhat compromised.

For air show purposes don't terminate your climb below 10,000 feet, and end it with enough speed so that you don't look all washed up to the few neck craners who are still following you.

If you get yourself committed to a steep pitch angle with airspeed falling away, immediately start a gentle pushover toward 0 G (not negative G) and then concentrate on the one parameter which will guarantee a flyable aircraft regardless of airspeed. This one parameter is angle of attack. Just hold indicated alpha between five and 10 units and you can keep the aircraft under control to airspeeds well below 100 KIAS.

The F-4B has a lot of performance potential. Whether or not you realize this potential is a matter of how well you understand performance parameters and your aircraft. The best advice on showing off is still—don't. The next best advice is "If you're going to show off, know what you're doing so that you do a good, safe job of it." *"Field Service Digest"* ●

To Feather or

by CDR William E. Chapline, USCG

Fortunately rather infrequently, you as pilot are called upon to render a decision as to whether or not to secure a "sick" engine or to try to keep it operating.

After consideration of all factors involved; i.e., symptoms *vs.* a multitude of operational factors such as type and performance of aircraft, distance from base or alternate, weather pattern . . . , you make what you believe to be the right decision.

Unfortunately, statistics are studded with accidents stemming from faulty decisions by pilots in this regard, particularly as pertains to operation of twin engine aircraft. In short, records have shown that many pilots have been overzealous in their desire to feather and save the engine without giving due regard to the often serious operational factors pertaining to the remainder of the flight.

It is desired to point out that this article pertains to a malfunctioning engine rather than a complete or sudden failure wherein the proper course of action is rather obvious. It is realized that a malfunction can lead to a complete failure; however, there are many minor difficulties that will cause malfunction but not necessarily complete failure; at least not until after many hours of operation—enough to get you home!

Fortunately few engines fail suddenly and without warning. Thus a pilot often has from seconds to minutes to hours wherein he can observe the engine and gages, diagnose the difficulty and perhaps nurse the engine along and derive some useful power. Most every case is different, of course, and there is always some calculated risk in continuing to operate a malfunctioning engine. The important point to remember is not to reach for the feathering button until you have considered all of the consequences!

What can a pilot do for a malfunctioning engine that will tend to reduce the probability of additional or complete failure and/or perhaps minimize or eliminate the symptoms? (The obvious indications of failure that often show up on the gages will not be considered in this article.)

A normal checklist for diagnosing the trouble plaguing a malfunctioning engine would be somewhat as listed below:

1. Engine instruments check.
2. Mixture rich, fuel boost ON.
3. Check carburetor heat.
4. Reduce manifold pressure to a below normal setting.
5. Visual observation of engine for oil loss, smoke, vibration, etc.
6. Check magnetos while watching engine and/or tachometer.
7. Reduce RPM to approximately 1300-1500, also reduce MP if appropriate—see item 4.
8. Use of engine analyzer.

Each of the items are now discussed separately for refinements:

1. Obvious.

2. Experiment with mixture control; if rich, try lean and vice versa. Hold down the primer. If engine smooths out, it was running too lean, if it roughens or ceases to deliver power it was probably running rich, in which case try manual leaning. Shift tanks if possible.

3. Obvious. At reduced manifold pressure employ slight excess heat and observe effect. If using heat try cold.

4. Reduced BMEP may help.

5. Source of oil loss on cowling or nacelle is often indicative of the nature of the trouble. Here a mechanic's advice is generally handy. (Remember a little oil can go a long way on a nacelle and wing!) If it is dark use a light to illuminate the nacelle. Smoke can be most revealing as to source and nature of the malfunction. Intermittent puffs of white smoke from under the cowling is generally caused by oil striking a hot surface such as the hot manifold. Excessive smoke pouring from the exhaust stacks or collector ring is generally indicative of a mechanical failure or mixture malfunction. Vibration can be caused by many things. Momentarily place the mixture control in IDLE-CUT-OFF and retard the throttle. If the vibration continues as the engine windmills, chances are you are facing imminent mechanical failure and the course of action is clear. Check the effect of cutting the fuel to the engine on any visible smoking.

6. Magneto check. Engines have been known to operate very satisfactorily on one or the other magneto but not on both. Use reduced manifold pressure and/or rich mixture.

7. Reduction of RPM. This reduces friction and reciprocating forces within the engine and minimizes the chances of additional failure or loss of a propeller due to sudden seizure.

8. Obvious.

Propeller and/or governor troubles can sometimes be the source of your malfunction, but generally the symptoms here are rather obvious. Never let warning lights stampede you into action that you may later have cause to regret. More often than not, the indication is false. Learn to analyze and diagnose your engine malfunctions and thus be in a better position to handle them in the air.

In an effort to simplify, many procedures become stereotyped when placed in a Flight Manual. Although it is generally presumed wise to have the manual on your side when attending a gathering around the "green table," this is no substitute for good head work nor does it always furnish a logical explanation for what you did under the circumstances prevailing.

—U.S.C.G. "Flight Safety Bulletin"

not to Feather

By
LCDR J. E. Colleary
BuWeps

PREMATURE

During the past two years the Bureau of Naval Weapons has sponsored premature bridle shedding investigations at Naval Air Engineering Laboratory, Philadelphia, Pa.; Naval Air Test Center, Patuxent River, Md.; and Naval Air Test Facility, Lakehurst, N. J. Combined results of the work accomplished to date indicate that four factors, occurring singly or in combination, are the most probable cause for premature shedding.

These factors are:

- Unintentional bridle mispositioning on the aircraft catapult hook by the hook-up crew.
- Bridle mispositioning caused by relative motion between the bridle terminal and the aircraft catapult hook after the hook-up crew had placed the bridle in the proper position on the hook and catapult tension applied.
- Bridle mispositioning because of bridle twist.
- Tension bar mispositioning.

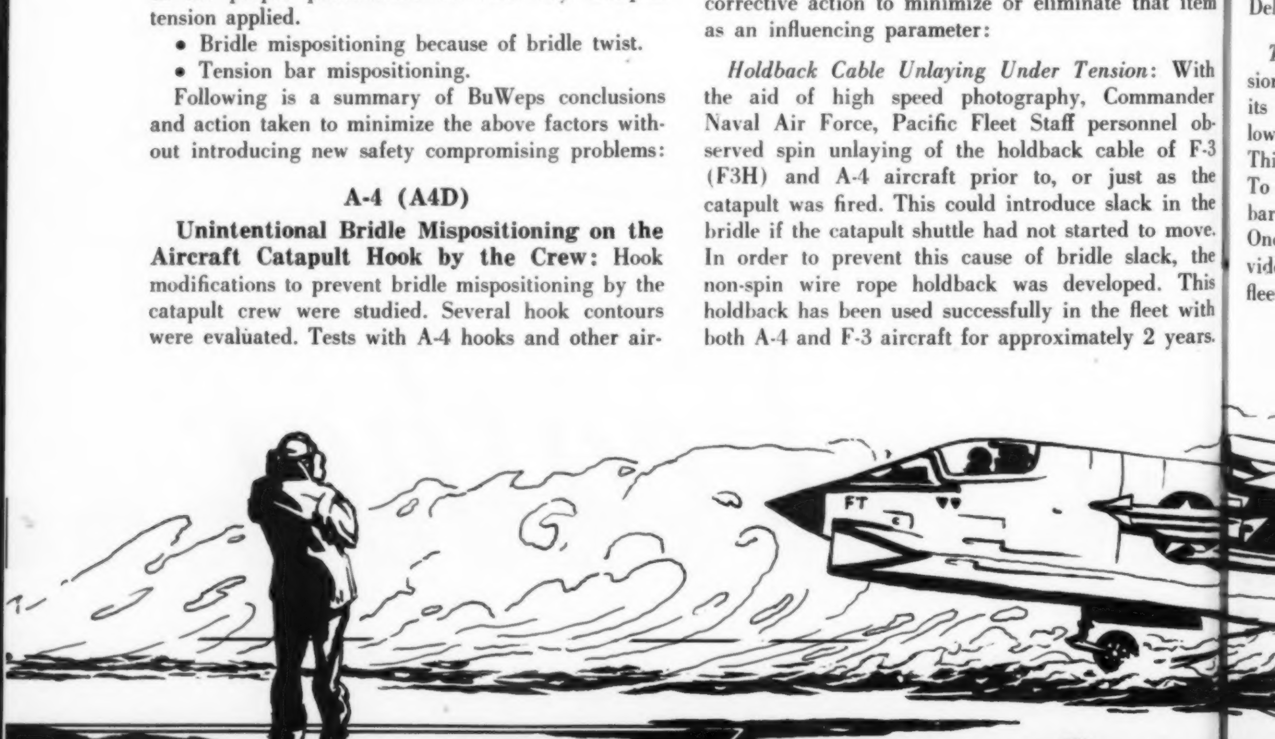
Following is a summary of BuWeps conclusions and action taken to minimize the above factors without introducing new safety compromising problems:

A-4 (A4D)

Unintentional Bridle Mispositioning on the Aircraft Catapult Hook by the Crew: Hook modifications to prevent bridle mispositioning by the catapult crew were studied. Several hook contours were evaluated. Tests with A-4 hooks and other aircraft hooks indicate that, to some extent, all hooks are subject to bridle mispositioning. Therefore, continuous emphasis in proper bridle hook-up and rigorous inspection after airplane tensioning are considered the only practical solutions to the crew mispositioning problem. Aircraft launching bulletins are being revised to reflect these precautions.

Bridle Mispositioning Due to Relative Motion Between Bridle Terminal and Aircraft Catapult Hook: Studies and tests have shown that there are several phenomena which may cause relative motion or bridle slack after the crew has completed hook-up. If sufficient relative motion occurs, mispositioning is possible. A breakdown of the items considered significant is shown below with BuWeps corrective action to minimize or eliminate that item as an influencing parameter:

Holdback Cable Unlaying Under Tension: With the aid of high speed photography, Commander Naval Air Force, Pacific Fleet Staff personnel observed spin unlaying of the holdback cable of F-3 (F3H) and A-4 aircraft prior to, or just as the catapult was fired. This could introduce slack in the bridle if the catapult shuttle had not started to move. In order to prevent this cause of bridle slack, the non-spin wire rope holdback was developed. This holdback has been used successfully in the fleet with both A-4 and F-3 aircraft for approximately 2 years.



Bridle Shedding

Catapult Hook Toe Length: Manifold A-4 catapult hooks, similar to the production hooks but with longer toe, were manufactured by the contractor and evaluated at NATC. These "long toe" catapult hooks augment the non-spin holdback solution to minimize premature bridle shedding for the following reasons:

1. Relative motion effect is significantly reduced because more relative motion is required before the terminal can reach the tip of the catapult hook where mispositioning occurs.

2. A mispositioned bridle on the toe of the catapult hook is more obvious to the catapult crew during hook-up.

The "long toe" catapult hooks have been approved by BuWeps and the contractor has manufactured them. Delivery of the first kit has been accomplished.

Tension Bar Mispositioning: A mispositioned tension bar may rupture prematurely, jump out of its socket entirely, or snap into position thereby allowing the airplane to surge forward prior to launch. This condition is conducive to bridle becoming slack. To insure proper seating and retention of the tension bar in the holdback, two programs were initiated. One immediate but temporary remedy was to provide interim retainer devices for the airplanes in the fleet. These devices are presently being used with varying degrees of success. The second program was to design and fabricate positive tension bar retainers for the airplane holdback fitting and deck holdback. The first integral airplane units have been tested and delivered while the deck holdback units have been tested and will be delivered in the near future.

Deck Holdback, Cleat Link Mispositioning: A mispositioned cleat link may fall in proper place or bounce free of the deck cleat during catapult tension. Either case would allow the airplane to move forward prior to launch. The Catapult Deck Gear and Accessories Service Bulletin requires usage of a retaining filler behind the deck cleat. Although the main purpose of this filler is to prevent holdback rebound, it will insure proper cleat positioning. A more operationally acceptable solution, consisting of a redesigned cleat link, is under study at this time and should be evaluated.

Pilot Holding Brakes During Tensioning: Holding brakes while tensioning, then releasing brakes may (if the holdback is not taut) cause the aircraft to move forward with attendant bridle slack.

Tests completed at NATC investigated the effects of improperly serviced tires and off-center spotting on premature bridle shedding. Results were that these conditions *did not*, by themselves, induce premature shedding.

Bridle Mispositioning Because of Bridle Twist: Bridle twist was considered a contributing factor to bridle mispositioning and an extensive development and evaluation program was conducted to study cause and effect of bridle twist. Bridles made with swaged strand wire rope and elongated eye terminals were found to be the best bridle configuration. The swaged strand wire rope reduced bridle twist during launch and the elongated eye terminals exhibited the best post launch shedding characteristics. A limited number of these bridles are being used by the fleet for further evaluation. Fleet delivery will commence in early 1963.

A-1 (AD)

Tests have just been completed at NATC investigating the effects of improperly serviced landing gear oleos and tires and off-center spotting on EA-1E/F (AD-5W/Q) premature bridle shedding. It was concluded "that of all conditions investigated, improper hook-up of the catapult launching equipment is considered to be the prime factor contributing to premature bridle separation." Mispositioning tests involving the A-1 revealed the following:

- The bridle is easily mispositioned on the catapult hook when standard hook-up procedures are used. The roughness of the A-1 wire rope bridle causes it to be more susceptible to mispositioning than those bridles equipped with forged eye terminals. Shaking may not dislodge the bridle.
- If a mispositioned bridle falls off one catapult hook subsequent to tensioning and inspection, the condition could go undiscovered at night. The other bridle leg would still be attached to the shuttle by the apex lanyard and the deck edge console would show a "first ready" condition.
- The bridle can be tensioned with the apex of the bridle on the restraining lip of the catapult shuttle.
- The holdback cleat can be mispositioned in the deck slot if the holdback assembly is put together with the deck cleat upside down. The holdback release assembly can be mispositioned on the airplane attaching ring upside down and/or properly installed.

F-8 (F8U)

Pendant drop-off without the tension bar breaking was experienced with the following combinations of conditions:

- Aircraft at Military Rated Thrust (MRT).
- Properly positioned tension bar and launching pendant.
- Slack in holdback which allowed 5 inches of aircraft forward motion when brakes released.
- 2500 lbs. horizontal tensioning force on the launching pendant [met previous requirement of 3500— (tolerance plus 500 lbs. or minus 1000 lbs.); new requirement in effect 3500 (plus or minus 500 lbs.)]

Launching pendant mispositioning, the only factor which by itself could cause premature shedding, could not be accomplished during the investigation. However, mispositioning is possible if the contacting surfaces of keel pin and/or claw tips are scored, gouged, or worn.

Premature shedding could also be caused by occurrence of two or more of the following conditions:

- Pilot holding brakes with slack in holdback.
- Mispositioned tension bar.
- Improperly serviced oleo struts, *especially nose strut.*
- Keel pin with scored surface.
- Claw tip with scored surface.
- Horizontal tension force of 2500 lbs. or less.

Integral tension bar retainers are being installed in fleet aircraft. Retainers for the deck holdback have been tested and will be delivered in the near future.

Minimizing Premature Bridle Shedding

The possibility of premature bridle shedding will be minimized to the limit attainable within present knowledge and state of the art when the following is attained:

- Optimized catapult hooks, launching bridles/pendants, and other launching accessories.
- Strict adherence to proper hook-up procedures.
- Strict adherence to use of proper launching accessories.
- Optimized night lighting in hook-up area.
- Rigorous pre-launch inspection of tensioned aircraft.

As stated previously in this article continuous emphasis in proper bridle hook-up, and rigorous inspection after airplane tensioning are considered practical solutions to the crew mispositioning problem.

The human element involved in hook-up of an airplane on a catapult is one of the most important factors affecting the success or failure of a launch; consequently, special emphasis must be placed on the human factor when providing a hook-up procedure which will be as satisfactory and as fool-proof as possible.

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OPS NOTES

Plane Captain Equipment

CVSG-57 Aviation Safety Officers reported that plane captains are equipped with life belts, whistles and flashlights for aircraft spotting movements during elevator movement, foul weather and darkness.—*USS* HORNET

Operation of Yellow Vehicles

Excessive speed and carrying of passengers on fenders have been noted. These practices are unauthorized and potentially dangerous. It is a continuous problem in all organizations and positive supervisory attention is required at all times. (Action for all activities)—*ComFAirHawaii*

Changes to NATOPS Manuals

Inherent in the NATOPS concept of operations is the desire to keep these manuals as current as possible. To accomplish this, information to update or to correct errors in existence must be received. The type training officer at NARTU is the Standarization Officer for any particular model aircraft. If any pilot notes an error in NATOPS, or if an improved means of performing any of the functions described in NATOPS can be found, constructive solutions should be forwarded to the Standardization Officer for that model aircraft.—*NARTU Jax*

Attendance at Safety Council Meetings

Flight surgeons are still conspicuous in their absence on attendance lists of approximately two-thirds of the Aviation Safety Council Meeting minutes received at the Safety Center. Occasionally the minutes of the Medical Committee are attached, but flight surgeons apparently have not attended the General Meeting. Medical officers should attend the General Meeting as well as the Medical Committee meeting in order to be aware of the problems discussed. Almost any problem in aviation safety can have medical ramifications.—*NASC Crossfeed*

Ditching Reminder

In reviewing the report of a successful P-2D (P2V-4) ditching during an uncontrollable engine fire, the following question was asked the plane commander. "Did you have any trouble determining your height above the water?" His answer. "None whatsoever . . . I'd think that it would be an important thing for a pilot to keep in mind (in ditching or crash landing a land plane) . . . that with the gear up he's going to be a lot closer to the ground or water at touchdown than he's accustomed to. This would be very important in preventing a stall before you hit—which is the one thing you want to avoid at all costs."

For more information on ditching land planes, see the APPROACH *for August 1960.—Ed.*

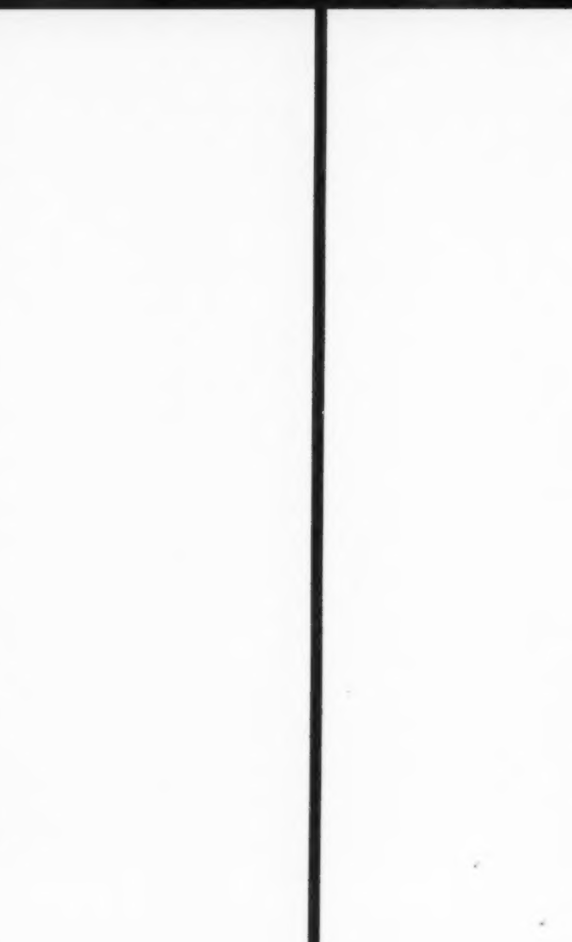
by E. V. Merritt and J. L. Reed
U. S. Army Transportation Research & Engineering Command

The problem of restraining cargo from movement during flight is becoming increasingly important in Army Aviation operations. Back when the cargo capacity of an aircraft was limited to one each, small-size RON kit, the problem did not exist. Anything larger than a case of C rations was automatically restrained from movement by the confines of the aircraft. Today the story is different, and the problem will become more acute as the cargo-carrying capability of Army aircraft is increased.

Adequate restraint of cargo is essential to the safety of the crew, the cargo, and the aircraft. No exception is taken with this doctrine; however, the degree of restraint required is open to question. Many believe that the restraint criteria as established in current publications for helicopters are excessive. These criteria prescribed restraint equal to or greater than that required for most fixed-wing aircraft.

Because of the inherent flight characteristics of the helicopter, the impulse reaction forces associated with cargo restraint in fixed-wing aircraft are not normally encountered. The relatively slow speed of the helicopter in normal flight tends to reduce the effects of gusts and turbulence. Consequently, the impulse reaction forces acting to shift cargo during flight, even in turbulence, are less severe in helicopters than in fixed-wing aircraft, and less restraint is required to prevent movement of cargo.

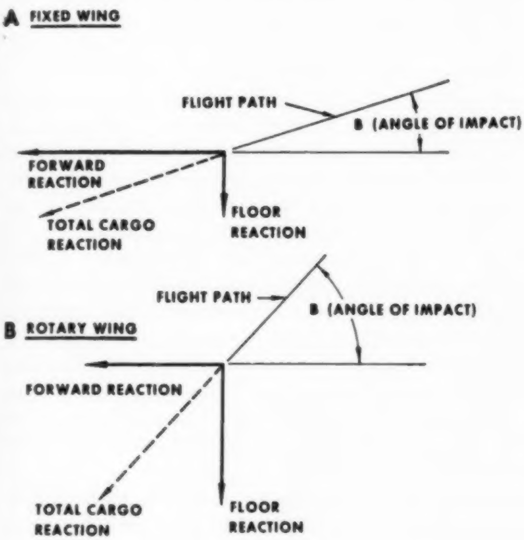
In an emergency, or even crash landing, the helicopter's steep descent and the angle of impact are such that the line of action of the reaction forces on the cargo is at a greater angle of impact than in



CARGO restraint

Figure 1

FORCES ASSOCIATED WITH IMPACT



a fixed-wing aircraft (see B, fig. 1). Fundamental physics prescribes that the net reaction force on the cargo upon impact will be in the direction of the motion of the system (i.e., the vehicle).

The reaction forces for fixed-wing and rotary-wing aircraft vary both in angularity and magnitude. The magnitude of the net reaction force is a function of the mass of the cargo (weight) and the rate of deceleration. Since fixed-wing aircraft have inherently higher velocities compared with rotary-wing vehicles, the deceleration forces upon impact are usually higher. By resolving the net reaction force into two fundamental components, namely, the forward reaction and the floor reaction, the degree of restraint required can be compared.

As was previously stated, the magnitude of the fixed-wing total cargo reaction force should be greater because of the increased impact velocity. Consequently, there is a higher rate of deceleration, providing all other factors are constant (time, distance for deceleration). This, possibly, is being somewhat conservative, but the distinction occurs not completely in magnitude of forces but also in resolution.

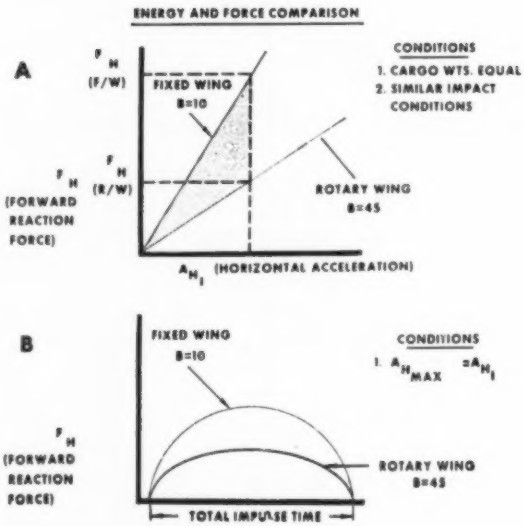
Owing to a greater angle of impact (B in fig. 1) because of flight profile, the forward reaction of cargo within a helicopter is approximately equal to the floor reaction. Less energy absorption is required to restrain the forward reaction of cargo in a helicopter than in a fixed wing aircraft, where the angle of impact is small and the forward reaction comprises a large percentage of the total cargo reaction force. The floor reaction is absorbed by the aircraft structure, whereas the forward reaction of the cargo must be restrained by the tiedown equipment.

A comparison of the force and energy absorption for the forward reaction is shown in figure 2. The curves shown are general since innumerable specific cases could be shown. The forward force is a linear function assuming linear accelerations and is plotted for the two types of aircraft (see fig. 2A). The range of B varies and consequently will affect the slope of the curves; however, the angles selected are a realistic comparative for the two systems.

Examination of the plots shows that the forward reaction ordinate difference sharply increases as the

in HELICOPTERS

Figure 2



horizontal acceleration increases. If the impulse shock build-up and degradation time versus the forward force are plotted (fig. 2B), the energy comparison can be established. If it is assumed that each aircraft lands under similar force conditions with respect to the cargo (the same deceleration and equal weight), the independent variables are the angle of the impact (B) and the forward reaction forces.

If figure 2A is used, the forward reaction for any maximum horizontal acceleration can be determined (examples, AH1). By integrating the areas under these curves from zero to AH1 and multiplying the specific impluse time shown in figure 2B, the energy difference measured in power units between the two systems can be found. Since the area difference is multiplied by a constant, the shaded area in figure 2A is a good representation of the energy difference.

It can be seen from this comparison that both the force and energy absorption requirements are lower for helicopters than for fixed wing. For the reasons previously stated, it is felt that the criteria for cargo restraint in helicopters are excessive and can be reduced and still retain a realistic degree of safety for the crew and equipment.

Lashing Material and Equipment

The lashing material, or tie-down equipment, presently available is not suitable, primarily because of the time required for installation. This equipment, which consists of A-1A tie-down devices (when available) and rope, is most commonly used for lashing cargo in helicopters. Practically any load of cargo can be secured when this equipment is used, if sufficient time is available for installing the number of lashings required. In the short-haul, shuttle-type of cargo movement operation, the time required for securing cargo becomes a significant factor.

In shuttle operations a turn-around time of from 10 to 15 minutes is not uncommon. That is, each helicopter completes the circuit from loading point to unloading point and back every 10 or 15 minutes. It is a bit ridiculous when the time required for lashing the cargo approaches that required for a complete trip around the circuit. In some cases this can cause the turn-around time on short-haul operations to be doubled.

For a one-trip movement or for a greater distance, a one-hour turn-around, the time required for securing cargo is of little consideration. However, the helicopter is best suited to short-haul, shuttle-type operations.

In view of this, two conclusions may be reached:

Securing of cargo to prevent injury to personnel and damage to equipment may be achieved with considerably less restraint than is now required.

The present method of securing cargo is impractical when the helicopter is engaged in short-haul, shuttle-type operations.

What Can Be Done?

Of the two primary problems, excessive restraint and unsuitable lashing equipment, the first probably is harder to solve. Reduction of the so-called safety factors, regardless of how excessive they may be, requires a very convincing argument. However, it should be possible through study and tests to determine the degree of restraint actually required.

The U. S. Army Transportation Research Command, Fort Eustis, Va., is investigating at this time to determine the actual forces encountered during flight by various type Army aircraft. This investigation is expected to determine the magnitude of forces to which cargo is subjected. When this information is available, establishment of more realistic criteria should be possible.

The second problem, unsuitable tie-down equipment, is more easily solved, especially after the restraint requirement has been decreased to a more realistic value. One method of providing the required degree of security is to spread web nets over the cargo and secure them to tie-down fittings in the cargo compartment floor. Provision for tightening the net could be made either by installing equipment in the cargo compartment at appropriate locations or carrying it as loose equipment. The nets and tensioning devices (winches) should of course be of lightweight, simple construction and easy to operate.

This is but one of the possible ways to use nets as a means of cargo restraint. Other obvious possibilities include installation of vertical nets across the cargo compartment to restrain the cargo from longitudinal movement. A similar method could be used to protect the crew from forward-moving cargo during crash landings. This method envisions a protective barrier net installed on the forward portion of the cargo compartment. Fastened to substantial structural members of the aircraft, this net would act as a crash barrier to protect the crew (see fig. 3).

Cargo aircraft procured in the future should provide built-in equipment for securing cargo. This can be accomplished as outlined above with extensible nets carried on built-in rollers; net barriers; or similar means. The use of nets would not, of course, be suitable for securing vehicles or other heavy, one-piece loads. In this case, the restraint devices (cable, straps) could be attached directly to the load and the proper tension applied by a winch or other device.

Conclusion

The thoughts and suggestions presented here are not new and are not expected to solve this problem. However, they are intended to point out the need for new criteria established on the basis of helicopter flight characteristics and the need for replacing antiquated cargo restraint methods and equipment. Reprinting restraint criteria establishéd for fixed-wing aircraft and being dependent on the ability of the loading crew to tie properly a Baker bowline and a slippery half hitch are not the best means of securing cargo in helicopters. It is time we stopped degrading the productivity of the helicopter by continued use of unrealistic and outdated methods of cargo restraint.

—*U. S. Army "Aviation Digest"*

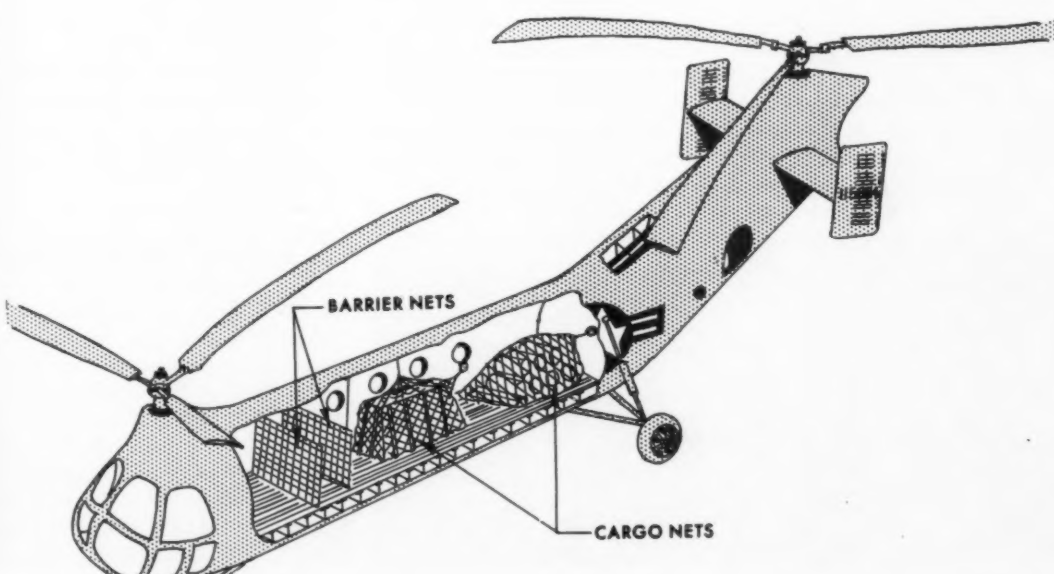


Figure 3

LONG RANGE, LOW LEVEL

"THE starboard engine of the P-2H (P2V-7) backfired once at 2300 rpm, 10 percent lean, advanced spark, 8000 feet density altitude, all temperatures normal. Carb Air Temperature (CAT) rose to 50°C., upon backfire. Engine was placed in RICH, spark retarded and operated at 100-103 torque.

"Ten minutes later the engine commenced uncontrollable backfires and violent vibration. CAT rose to 100°C., and reduced power would not stop backfires or vibrations. Engine was secured with 'E' lever."

Such was the way a Flight Hazard Report set up some single-engine work for this P-2H crew. They were enroute from Argentia to Puerto Rico and had been airborne for almost eight hours. At the time the starboard recip was feathered there remained a little over 400 miles to destination (also the nearest airfield).

"Operating the port reciprocating engine at 2600 rpm and 48" mp, and the starboard jet at 96 percent did not permit reaching the nearest airfield (Roosevelt Roads) with the fuel remaining.

"Operation on the port recip alone did not produce sufficient TAS to reach Roosevelt Roads considering the fuel remaining and incurred fuel flow, at an aircraft weight of 64,000 pounds. The aircraft was descended from 7000 feet pressure altitude to 500 feet off the water and 5120 pounds of aircraft equipment and personal effects were jettisoned in order to extend the range.

"An increase of 20 knots IAS was achieved by jettisoning, and the aircraft arrived at Roosevelt Roads 2 hours and 48 minutes later with 80 gallons of usable fuel remaining (18 minutes). Immediately prior to the engine failure, at the TAS being made good, destination airport would have been reached in 2 hours and 12 minutes. Also, there was fuel for 4 hours and 34 minutes at the existing power settings.

"At a density altitude of 8500 feet and aircraft weight of 64,000 pounds with 6400 pounds of fuel remaining at the time of feathering, the Flight Manual indicated that the aircraft should fly at a CAS of 185 knots with 2300 rpm, 108 torque and one jet at 96 per cent. This should yield .0615 nautical air miles per pound of fuel. In actuality, these power settings yielded only 155 knots CAS.

"Upon descent to sea density altitude the Flight Manual indicated the aircraft, then at 63,000 pounds, should yield 153 knots CAS at 2525 rpm, 138 torque with .093 nautical air miles per pound of fuel range. However, at 2600 rpm and 150 torque the CAS was only 135 and it became apparent that jettisoning of all unnecessary equipment was essential if ditching was to be avoided. Jettisoning of 5120 pounds permitted an initial increase in CAS to 145 knots."

Backside

WHEN the two F-8s (F8Us) taxied out for takeoff the 1300 runway temperature was 89°. The day of this mid-April flight was unusually warm as compared to the preceding weeks when the weather was predominately cool. With the existing headwind of 10 knots, it was later calculated that the takeoff distance would be 4300 feet using Military Rated Thrust at a weight of 26,000 pounds.

The leader, considered exceptionally well qualified in jet fighters by reason of experience and previous performance, had briefed for a section takeoff. To assist his wingman in maintaining position during takeoff the lead pilot set his power at 96 percent.

Following brake release the initial roll was normal. However, the leader started the nose of his aircraft up to takeoff attitude at a much lower indicated airspeed than is recommended. This attitude according to his wingman was higher than that used by other pilots. Prior to actual liftoff the leader's attitude was increased even higher. Despite the fact he was using 2 percent less than MRT he was seen to be airborne at 3800 feet.

The wingman attempted to get airborne with the leader and added back pressure but after a slight skip he dropped back to the runway. The wingman's increased

truth and consequences A REVIEW OF SIGNIFICANT AIRCRAFT ACCIDENTS

power and flatter angle of attack later enabled him to liftoff, slowly gain altitude and gradually overtake the leader.

During this time the leader had increased speed to approximately 140-145 knots. He raised his landing gear but realized he was not accelerating and added throttle to acquire full MRT. He also raised the nose of his aircraft slightly but this did not alter his altitude. Due to his high angle of attack MRT was insufficient to provide adequate acceleration.

The aircraft attained a maximum altitude of 75 to 100 feet and an IAS not exceeding 150 knots. Realizing that the takeoff was not going to be successful the leader had the choice of landing and trying to pick up the abort gear, crashland straight ahead, or eject. His decision was to eject.

Over the end of the runway he increased his angle of attack to attain maximum altitude for ejection but this aggravated an already critical situation and caused a pronounced settling. The face curtain was pulled and the canopy apparently left the aircraft at the same instant the tail contacted the ground. During a skip back in the air the pilot departed the aircraft in his ejection. The chute was seen to blossom on a horizontal plane, just prior to the pilot making contact with the ground. "I was aware of being thrown around in space," he said, "and the next thing I was aware of was hitting the ground and rolling around in the dust."

How and why did it happen? The accident board believes the leader became airborne prematurely through error in takeoff procedure. He was then confronted with an undesirable situation (very slow acceleration) which developed into an emergency. Recognizing that an emergency existed the sensations he experienced convinced him he was experiencing power loss. "I considered using afterburner at this time," he said, "but concluded it would do me no good and possibly some harm."

The engine was intact after the accident and all suspected reasons associated with engine failure or malfunction were eliminated by disassembly and inspection though in fairness to the pilot it remains a point for consideration.

Incorrect analysis occurred, the board felt, because the pilot had never experienced a similar situation before and since the accident occurred within a matter of seconds once airborne, a revaluation of the situation was impossible.

"It is felt," noted the squadron commander, "that on occasion pilots of high performance aircraft tend to become complacent with the issue of power required versus power available, due to the high thrust to weight ratio of current afterburning aircraft. This feeling lends itself to the belief that excessive thrust available will resolve any problem associated with takeoff technique."

While the relatively high runway temperature may have been a contributing factor "it is the opinion of the board that the pilot rotated the aircraft to the takeoff attitude too soon and became airborne prematurely with an excessive angle of attack. This angle of attack was so great that full MRT would not provide adequate acceleration. This angle of attack was further increased to an angle which caused deceleration and pronounced settling. Had afterburner been used prior to the settling, recovery might have been effected."

TO FEATHER OR NOT TO FEATHER: An S-2 (S2F) single engine at sea is quite different from a P-2 (P2V) engine failure over the mountains, or a KC-130F (GV-1) shut down at point of no return. Whatever recip you fly, you'll profit by the general advice on the subject on page 4.

NATOPS should stimulate cockpit headwork—not eliminate it. If you have a good idea, stick to your guns—but comply with NATOPS machinery so all may benefit.

NATOPS Model Manager

by CDR Ken Carter

The October 1962 issue of APPROACH contained information on NATOPS that covered the entire program very thoroughly. This article is intended to answer the question of *Who and Why* certain people are telling us how to operate aircraft.

Overall, CNO has designated a cognizant command for each Naval aircraft model responsible for the preparation and continued up-dating of the NATOPS manual. In the Pacific Fleet, ComNavAirPac has designated a model manager for each naval aircraft it has cognizant command of. The model manager is the squadron or activity most closely associated with the particular aircraft, and the model manager is responsible to ComNavAirPac for the implementation of the NATOPS program within NavAirPac for this aircraft. The responsibilities of the model manager include:

- Preparation of NATOPS manual and supplements.
- Review of proposed changes.
- Review of AARs and Ground Hazard Reports.
- Conduct of standardization training and checks.
- Conduct of standardization inspections.
- Maintenance of close liaison on NATOPS matters with model users as head of the local standardization board for the model.

Now, how does the Model Manager concept work? Let's look at it from a candid angle in a typical case. Cognizant command: that's ComNavAirPac for many aircraft models among them the (P-2) P2V, (P-5) P5M, and (U-16) UF. Model Manager: Patrol Squadron THIRTY-ONE, Pacific Fleet's VP RAG squadron.

Anyone in the Aeronautical Organization can generate a change to a NATOPS manual. Using the P-2 as an example, let's generate a change and follow it through step by step.

a. A NavAirLant squadron determines a change in NATOPS is required. If they consider it urgent they kick it off in a priority message to ComNavAirLant; otherwise, it goes by letter.

b. The recommendation, if considered valid, will then be forwarded to ComNavAirPac, the cognizant command for the P-2 with copies to all other Standardization Advisory Group members. All major Navy and Marine Corps aviation commands, the Bureau of Naval Weapons, and the Chief of Naval Operations constitute the Standardization Advisory

Group.

c. ComNavAirPac's Standardization Coordinator will collect the comments and recommendations forwarded by the other members of the Advisory Group and discuss them with the P-2 model manager, VP-31. Recommendations concerning the change are then forwarded to CNO by ComNavAirPac. Recommendations of a routine nature will be acted upon at the semiannual NATOPS/Flight Manual review conference. Urgent changes are issued as soon as possible.

That's the big picture, simplified. The NavAirPac Standardization Coordinator can't be an expert in every model; he is assisted by the model managers within the command. In the case of P-2 matters, VP-31 formulates recommendations through their model Standardization Board. This Board is staffed with the most experienced pilots in the squadron; and since VP-31 staff pilots have all had recent experience in the various Fleet VP squadrons, all areas of Fleet operations can be given consideration in arriving at recommendations.

The VP-31 Standardization Evaluator is a primary billet on the Department Head Level. The most experienced LCDR available is assigned to this billet. He does not make decisions or recommendations above the command level. This is a function of the Standardization Board and the Commanding Officer.

The policy of the VP-31 Standardization Board is to recommend NATOPS procedures that will meet the requirements of the lowest common denominator and provide the greatest margin of safety without impairing operational readiness. Procedures that increase the cost per flight hour are not recommended unless they are imperative to safety.

An example of working to the lowest common denominator is found in the instrument approach procedure. It would be impossible to write a standard procedure for every variation of weight, weather, location and flight conditions. We try to give you an instrument approach, designed for the least experienced plane commander in your squadron, that will work at Kodiak in the winter or Roosevelt Roads in the summer. If this isn't practical, then, and only then do we come up with two procedures. The idea is to establish a norm based on the concept that if you are prepared for the worst, anything less than the worst will increase the odds in your favor.

The NATOPS Supplement grading criteria allows tolerances in the performance of manuevers, and common sense requires all pilots to apply the general prudential rule. Therefore, it is not considered desirable to crank excessive variables into the basic manual. *The Plane Commander is NOT restricted from using his judgment in these matters; in fact, his judgment is graded on standardization checks.* It is not the intent of NATOPS to develop "puppet pilots," but rather to establish a norm with the best known operational procedures. *NATOPS should stimulate headwork, not eliminate it!*

The NATOPS and RAG programs are designed to work together to improve readiness through safety and efficiency. The goal will be achieved if we face the problems with the right attitude. Don't be discouraged or disgruntled if all of your pet proposals aren't immediately accepted and published. It took me three months and nine thousand miles of travel to get an agreement on a flap setting change, and I'm the XO of this model manager squadron. If you have a good idea, stick to your guns; but comply with the NATOPS machinery so that we may all benefit.

CDR Ken Carter was designated a Naval Aviator in October 1944. He is now serving his third tour in a training squadron, having previously been a ground and flight instructor in both jet and conventional aircraft. He holds current FAA Airline Transport Pilot and Instructor Ratings and has qualified in both landplanes and seaplanes. CDR Carter has had two VP tours; one on the east coast with VP-34, and one in the Pacific with VP-48. A firm believer in standardization, he is convinced it is the key to progress. He is now attached to VP-31 as Executive Officer.

The AGING

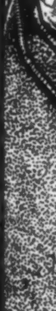
We all accept the fact that there are differences between a man at age 25 and this same man 50 years later. These differences may all be neatly tied together and referred to in a single term "the aging process." The aging process is very gradual in occurrence and extremely variable with the individual.

Interestingly enough, the first change many older pilots notice is not a physical one but rather an emotional one manifested by signs of increased caution while flying. This in fact represents the second of four emotional phases that most pilots pass through during the course of many years of flying. The first of these phases is represented by a carefree attitude with little serious thought devoted to the hazards present during flight. The second, as already noted, is an increasing degree of caution. This generally stems from increased responsibility, mishaps involving contemporaries and accumulated experience. The third phase is an expansion of normal caution into distaste or sometimes even controlled fear of flying. Finally this gives way to the last phase of emotional change which is a realistic acceptance of both the hazards and the pleasures of flight tempered by proper caution and experience. In effect, the coming of caution may be considered as preparation for the aging of physical capabilities.

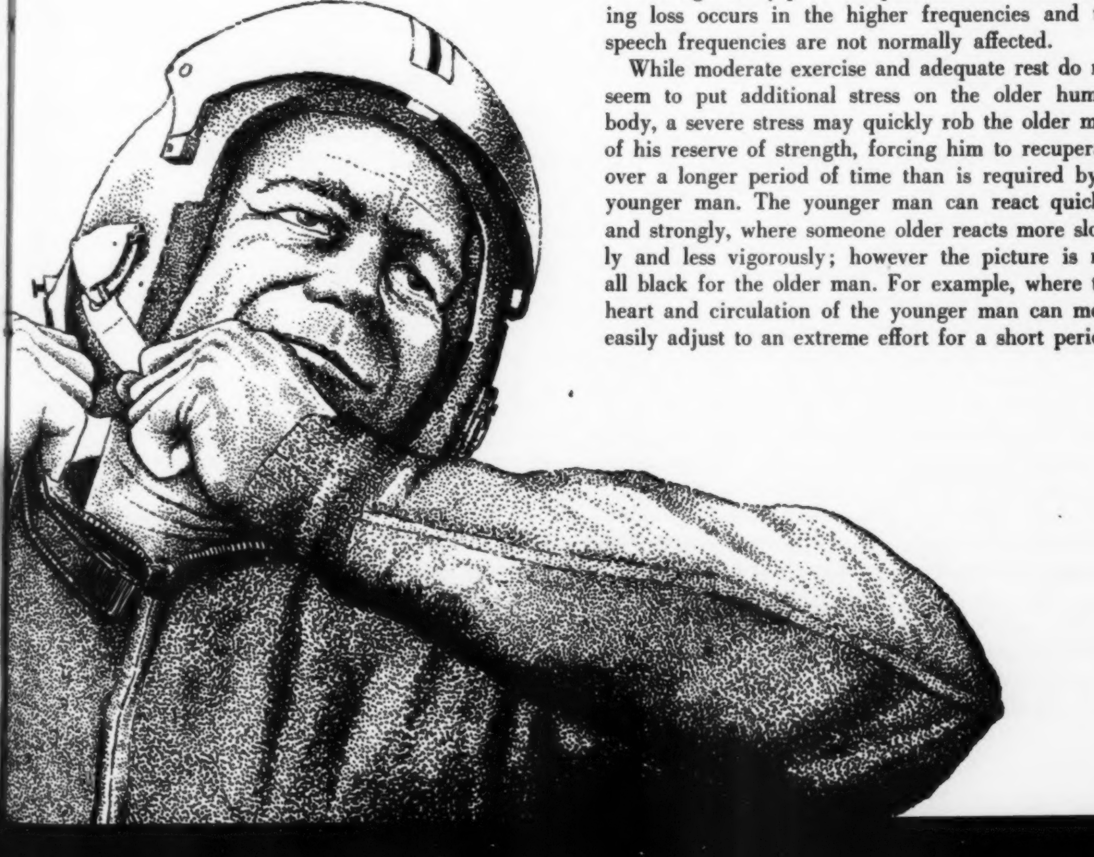
Often the first sign of physical aging shows itself as an increasing degree of difficulty in fighting off fatigue. The pilot who was able to "live it up" at night, go short on sleep and still be able to put in a good day's work on the following day when he was 23 years old finds that by the time he is hoping to make major he can no longer work a full day after little sleep without being very much aware of how tired he is. This decrease in the ability to handle certain body stresses generally becomes apparent in the late 20's to early 30's and as the years progress other reactions to aging become apparent. Extremes of temperature, whether specific or climate, become less tolerable. This is due to decreased body heat production and lessened muscle activity in situations involving low temperatures, and more limited dissipation of body heat through the skin in high temperatures.

Perhaps the one single factor which more frequently than any other draws an individual's attention to the fact that he is aging is a change in his visual acuity. This is easily understandable since the ability to see, and see well, is of vital importance to the pilot and any diminishment in this ability will not long remain unnoticed. Even if the individual should happen not to notice this change for a while, it will soon be uncovered when he takes his annual physical and is reassured by his flight surgeon that this is a normal aging phenomenon and henceforth he must wear glasses to fly. Actually the lens of the eye begins to harden in late childhood although this does not become apparent until about age 40, on the average, when the ability to focus on near objects becomes affected. Also often present is loss of sharpness of focus for distant objects.

Other less apparent changes in vision with increasing age are a gradual narrowing of the visual fields or cutting down a little on the ability to "see out of the corner of the eye," and an increasing loss of night vision. It is interesting to note that the older eye will make its adjustment to the dark as rapidly as the younger one, but does not attain the same level



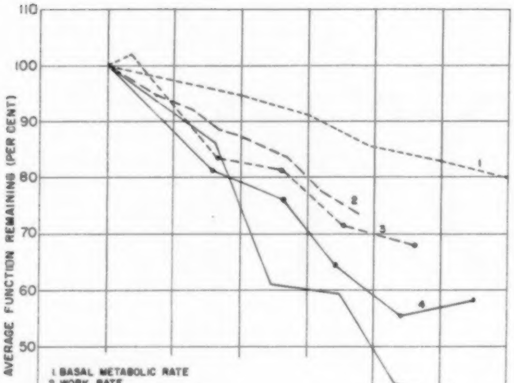
PILOT

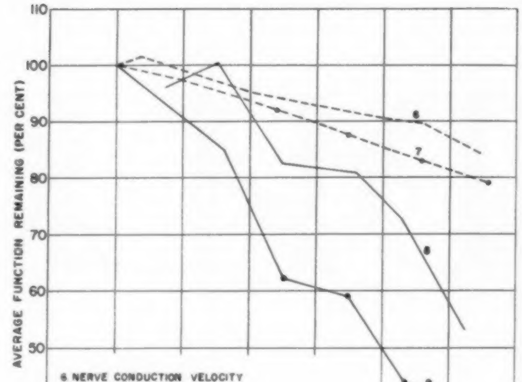


of sensitivity. As a result of this, the 45-year-old pilot may need 150 percent more illumination at night than a 25-year-old pilot. There is no doubt that the eyes of the younger man are desirable in landings under minimal light conditions.

The sense of hearing declines with age but this does not generally present a problem since most hearing loss occurs in the higher frequencies and the speech frequencies are not normally affected.

While moderate exercise and adequate rest do not seem to put additional stress on the older human body, a severe stress may quickly rob the older man of his reserve of strength, forcing him to recuperate over a longer period of time than is required by a younger man. The younger man can react quickly and strongly, where someone older reacts more slowly and less vigorously; however the picture is not all black for the older man. For example, where the heart and circulation of the younger man can more easily adjust to an extreme effort for a short period,





the system of a slightly older, healthy man has an increased capacity for endurance which allows him to outlast the younger one in a prolonged but less strenuous task. An astronaut in his late 30's is physically and mentally better equipped for his work than a man 15 years or more younger.

The fact that it is easier to learn something at a young age than at an older age should not be a deterrent to acquiring new knowledge as the years go by. The older man needs more time to learn new material and stronger impressions to stimulate his memory but by the time this becomes apparent he has usually also developed the patience necessary to keep the increased burden of learning from being a chore. Generally, the older pilots' greatest difficulty in learning something new occurs when this requires the "unlearning" of old knowledge and practices as is the case when a man has to transition from reciprocating multi-engine aircraft to single seat jets. It is within the individual's own ability to delay the occurrence of a slow-down in mental activity since it has been shown that the mind which is constantly stimulated by experience, judgment and reasoning is more able to resist the erosions of age.

No mention has been made thus far of any disease processes that are more apt to occur in the older individual. It would not serve any function to enumerate every illness that is generally associated with aging. However, there are certain of these disease states which are worthy of mention because they can often be avoided or delayed by a very simple method available to each and every one of us. Mild forms of diabetes, certain cardiac conditions and high blood pressure occurring after the age of 40 are all aggravated by *obesity*. Indeed, part of the treatment of all these conditions in the heavy individual is diet. Many mild diabetics are completely controlled on diet alone. Therefore, does it not follow that if these individuals whose condition is benefitted by weight reduction had been at an optimal weight to begin with the occurrence of the disease state itself may very well have remained potential rather than actual. Any of the three diseases mentioned calls for permanent suspension from flying duties so those readers who may have just a few extra pounds hanging on may save several years of flying pay, in addition to adding years onto their lives, if they start trimming down now.—*Fifth AF "Flight Safety News"*

"Everyone hears of serious aviation accidents, but few know of those that are prevented . . ."
—Flight Safety Foundation

'. . . Getting the Facts, Ma'am!'

Crash investigators often report difficulties getting the facts from witnesses. Here's one report by the Norfolk SAR Coordinator which tops their best stories to date. It's Case 134 reported by the "Norfolk DF-Radar Net," Monthly SAR Summary.

Time of Initial Alert:
1431R,

Alerting Station: Hickory

Nature of Distress:
Possible ejection

Weather: CAVU

1431R Hickory advised an *aircraft* was down in vicinity of Lake Catherine (35 miles 268° from Cherry Point).

1434R Cherry Point advised that two fire towers *sighted* an airborne explosion and one parachute, vicinity of highway 53. R4D airborne to search.

1435R Hickory advised a farmer had *seen* an *aircraft* and a parachute.

1437R MCAS New River advised that at *1345R* the Chinquapan Fire Tower *sighted* an airborne explosion and obtained a bearing of 079°, estimated 5 miles, T-28 and HR4S airborne to search.

1445R RCC requested all stations account for aircraft.

1449R Cherry Point launched 2 OEs and a helicopter. State Police alerted. Rescue Coordination Center requested a helicopter land and interrogate witnesses.

1514R Helicopter landed and talked to lady witness. She said it happened at 1100R.

1521R Cherry Point advised that the lady heard an explosion and saw something drop from the sky, then reported it to the forest tower.

Results:

1530R Cherry Point's investigation revealed that a whirlwind had picked up some cloth tobacco seedbed covers and at the same time an aircraft had broken the sound barrier. No aircraft overdue. Case closed.

Comments: This case is good for more than laughs. It's a lesson in the value of second and third hand information passed by word of mouth versus complete, accurate, verbatim reporting.

SAR Ground Party Tips

The Norfolk SAR Bulletin, commenting on a recent accident and search for survivors, said, "Roses to all the participants. Not to detract from their performance, there are two things that should not happen again:

1. *Place names.* Don't refer to geographic positions by names known only by the local natives. "Charity Church", "Hill's Boat Landing", and "Pungo Bridge" were important locations but plotting them on a map is impossible —they exist only in the local vernacular. "Charity Church" is a local name for a wide spot in the road. It's also the name of a church 3 miles from the wide spot. RCC never would have located it except the assistant duty officer was married there. Considerable confusion resulted after RCC phoned the church and the good pastor vowed there was no burning airplane nearby. "Pungo Bridge" is 8.4 miles from the hamlet of Pungo and RCC never did locate it until the case was concluded. As of this writing "Hill's Boat Landing" has not been found and the phone company does not list it.

RCC uses official State Highway Department maps for land searches. These maps are to a scale of 1" to a mile, depict each building by type (gas station, school, factory, church, house, etc.) and show all primary and secondary roads by route number. The best way to transcribe the location of a ground object to a map in an area where there are lots of roads is to describe the location in relation to the roads, i.e., 300 yards north of the intersection of U.S. 13 and County 1502.

2. *False Alarms.* The red flares sighted at 2330 were fired by the ground search party to signal the missing pilot. If the search participants are going to do anything that could be mistaken for the missing person, the SAR Mission Coordinator should be informed prior to commencing the action. Every search has its share of false alarms. Let's not generate our own." —*Norfolk DF-Radar Net*

HEADMOUSE

MAN OVERBOARD!

Dear Headmouse:

Shortly after 1600 my aircrewman and I were launched from the carrier in a UH-25B (HUP-2) to act as plane guard for the scheduled 1630 launch. Two minutes later I heard a radio transmission from the LSO on Launch/Departure frequency that a man had fallen overboard from the flight deck, port side aft. The ship was in a starboard turn, coming into the wind to launch aircraft and I was in the Delta pattern approximately 300 yards off the starboard quarter, heading in the opposite direction.

I commenced a hard right turn toward the ship and almost immediately saw a yellow buoy close astern; I crossed the ship's wake and headed toward it. The man was 150 feet from the buoy. At first with his blue flight deck jersey and helmet he was barely visible in the swirling water directly in the ship's wake. He had no emergency flotation equipment and was struggling frantically in the churning water.

With 20 knots of true wind the helicopter was easily brought to a hover over the survivor. My crewman lowered the rescue seat to him. After what seemed to me to be several minutes, the hoist cable was still down and I was aware that my crewman was experiencing some difficulty. There were several radio transmissions which partially garbled ICS communication with my crewman and I was uncertain as to exactly what was taking place. Finally I learned that the survivor was not properly seated on the rescue seat but that my crewman was bringing the hoist up. The survivor had thrown his arms around the seat shank the instant it came within his reach and made no further effort to seat himself properly. He appeared to have facial injuries and to be strangling.

When the rescue seat reached the limit of its upward travel, I could see that the survivor was still clinging to it with his arms. His entire body was dangling out the bottom of the rescue hatch. It was impossible to close the hatch or to bring the seat any higher and I could see that he was not cooperating with the crewman's efforts to bring him inside the helicopter. I was convinced that the survivor would fall back through the open hatch at any moment and decided to lower him back into the water along with my crewman and a raft. Then I saw my crewman heave the survivor up through the hatch into the helicopter, still unable to break his grip on the rescue seat. Even at the time this impressed me as quite a remarkable feat of strength as the survivor was obviously considerably larger than my crewman (who is a slightly built person) and probably outweighed him by close to 50 pounds. With the survivor safely aboard, we returned immediately to the ship to discharge him and then resumed plane guard duty.

I have two recommendations:

- Investigate the possibility of replacing the blue flight deck jerseys and helmets presently in use with some high visibility color. The color should contrast as sharply as possible with the water. The blue clothing now in use blends almost perfectly with the sea and makes it extremely difficult to spot.
- Equip all flight deck personnel at all times with a compact life jacket which can be worn around the waist.

ANYMOUSE

▶ Spotting flight deck personnel in the water is indeed a problem. Adding high visibility colors to the present flight deck jersey and helmet color coding system might confuse pilots. Stitching colored stripes, etc. to the jerseys presently in use does not seem practical because of the looseness of the jersey material and the frequent launderings necessary aboard ship. Perhaps the problem should be attacked from another angle—for instance, attaching locating devices such as dye marker, whistle and flashlight to a life preserver that would be suitably worn at all times while flight deck personnel are at flight quarters. One type of lifebelt, which is a 2″ wide CO_2 inflated belt fitted around the waist, has been proposed to BuWeps as a type of belt which may be worn without undue discomfort or hampering duties of flight deck personnel. At this date, no report of evaluation has been received.

Very Resp'y,

Headmouse

Pencil Flare Gun

Dear Headmouse,

I have noticed that some naval aviators are carrying a pencil type flare gun as a supplementary type signalling device. It looks good to me and I would like to have one in the event I had used my two old MK-13s to no avail, or they had failed to operate (as often is the case).

Is the Bureau of Naval Weapons considering making this pencil type flare gun available to all naval aviators as an approved stock item emergency signalling device?

ANYMOUSE

▶ BuWeps reports that it is aware of several pencil size flare and gun kits, all very similar in design. Several are being evaluated at the present time. Upon completion Bu-

Weps says pertinent recommendations will be made to CNO.

Very Resp'y,

Headmouse

A4C Daily & Preflight Sheet

Dear Headmouse:

A short time ago, a Quality Control type Anymouse had been showing a prospective A-4C (A4D-2N) plane captain how to use the Daily and Preflight Sheet. All went fairly well, except on several occasions when it became necessary to back track or go to another section to the aircraft to cover each item as it was presented in the check sheet. However, on coming to item 26, ROCKET EJECTION SEAT, it was necessary to come to a complete halt.

The problem was, there seemed to be more pins to check than Q.C. Anymouse could account for. Item 26(a) states, "lap belt and shoulder harness fitting for security in *retaining pins;* pins for proper protrusion:" Item 26(c) states, "parachute harness straps for proper engagement with *release pins.*" This presented some confusion until a check with the HMI and the squadron AME's revealed that the "release" and "retaining" pins are one and the same. Another problem came up when item 26(1) was encountered, which states, "harness release actuator cartridge indicator pin for proper protrusion." Another check with HMI and squadron AMEs revealed this pin should not protrude unless said cartridge is missing.

This Anymouse believes the Daily and Preflight Sheet would be more effective if:

1. Items were listed in such a manner that backtracking and skipping from one place to another on the aircraft would be unnecessary.
2. Use correct nomenclature, and one nomenclature only, for each item.
3. Be more specific in what to check for. (The "proper protrusion" in item 26(1) suggests to this Anymouse that the pin should protrude under normal conditions.)

ANYMOUSE, VA-172

▶ Your points to make the Daily and Preflight Sheets more effective appear to be good ones. The following is quoted from the Introduction page of the Handbook Inspection Requirements Daily and Preflight.

"Revisions to this handbook will be published when necessary to add, delete, revise or change requirements. Such revisions will be based on factual data accumulated as a result of maintenance experience with the aircraft concerned. Data will be gathered by field studies, from Failure Reports, and from any source that uses this handbook and its requirements. Recommendations proposing changes to this handbook are requested and should be submitted via the Type Commander to the *Commander, Naval Air Test Center, Patuxent River, Maryland, Attention: Inspection Requirements Branch, Service Test Division.*"

A copy of your letter has been forwarded.

Very Resp'y,

Headmouse

DF Shadow Tip

Bob Owendoff, a 17-year old lad from Falls Church, Virginia, worked out a system last year, called "shadow tip" method of determining direction. You must be on the ground to use it. The Air Force recently adopted the plan.

When Bob was in high school, he enlisted the aid of mathematicians at three universities to help him explain why the tip of a stick's shadow draws an EW line. It is said to be more accurate than other methods used by a person lost without a compass.

Bob has published a booklet and wallet-sized card describing the shadow-tip method.

It works like this:

Stick a branch at least 3 feet long into the ground. Mark the tip of the shadow once and then a second time about 10 minutes later. A line drawn between the two marks points east and west. The second mark is always toward the east.

Bob says more than 50,000 trials of the method show it is more accurate than other emergency systems and is usually truer than magnetic compass readings. —*Cross-Country News*

CCA Glide Slope?

Dear Headmouse:

In reference to LCDR Goode's article entitled "The CCA Story" in the January 1963 issue of APPROACH, I am confused concerning this use of the term "glide slope" in the second line of the article.

Although I have never flown a CCA it is my understanding that no height finding radar is available. How then can a CCA controller tell a pilot he is on glide slope?

ANYMOUSE

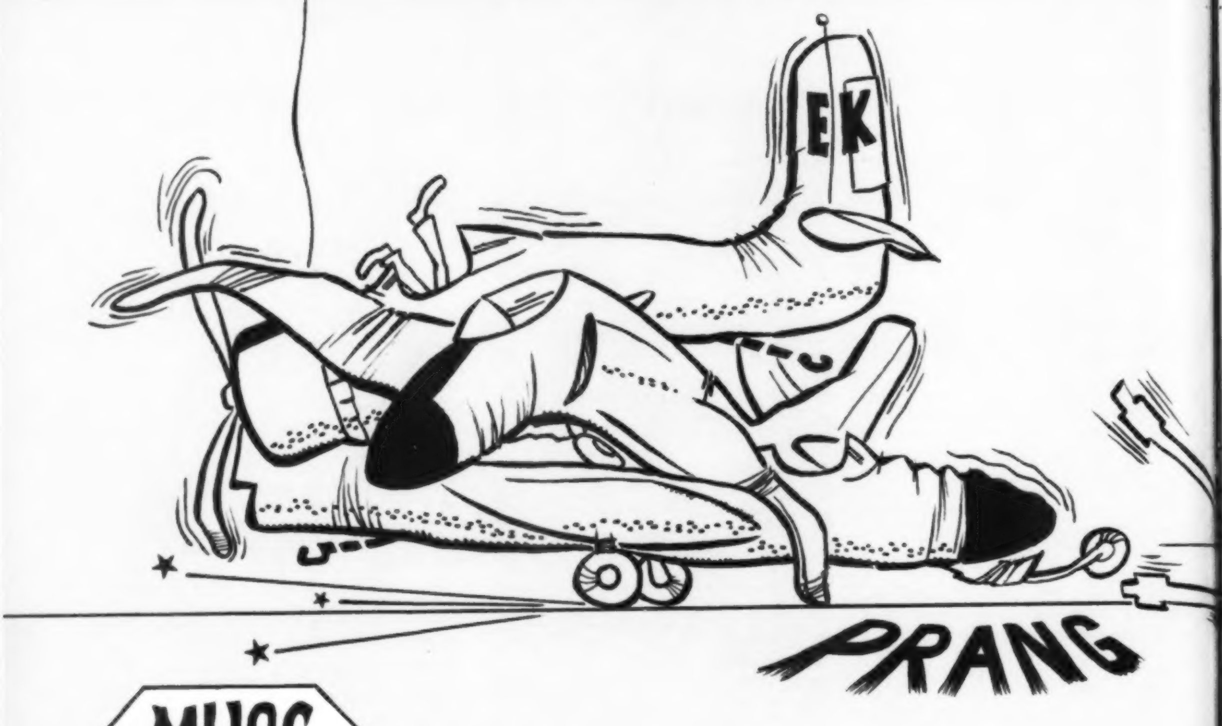
▶ CCA controllers do not have the radar glide slope information available to GCA controllers.

The glide slope the author was referencing was the visual glide path established by the mirror or FLOLS—not a radar glide slope normally associated with GCA. Doctrine requires the pilot to be at 600 feet at the time he will intercept this visual glide slope. It was a simple matter for LCDR Goode to determine the point in range astern where the visual glide slope would be intercepted by an aircraft at 600 feet. This is the point at which USS SARATOGA CCA controllers made the transmission quoted by the author in the first two lines of his article. Upon receiving this transmission, the pilot making a CCA on a black, black night could reasonably expect to glance up from his instruments and see the meatball, visibility permitting.

Very Resp'y,

Headmouse

Have you a question? Send it to Headmouse, U.S. Naval Aviation Safety Center, Norfolk 11, Virginia. He'll do his best to help.



MUGS WAS HERE

. . .and here *. . .and here* *. . .and here*

. . .and here ***. . .and here*** ***. . .and here***

The hurrier he goes, the behinder he gets.

Split

To learn to fly jet aircraft, a pilot must study and fly jet aircraft. This statement seems pretty obvious. And it applies not only to pilots and crewmen but, in a sense, to flight surgeons as well. A flight surgeon cannot perform his job with the squadron or air group at maximum efficiency unless he flies with the unit.

For a flight surgeon to do the job he is intended to do, he must know his pilots and crewmen and their problems and he must know them *firsthand*. This means attending all pilots' meetings and safety councils . . . getting out in the work areas, on the line, in the loft and in the hangars . . . talking to the men on the job . . . joining their Happy Hours . . . *not* just sitting behind a desk, pushing papers and holding sick call. It means getting flight time in operational and training hops such as in the back seat of multi-place jets, if he is assigned to a jet activity, or in operational multi-engine patrol planes . . . *not* settling comfortably in the back seat of an SNB or R4D once a month.

Many flight surgeons are themselves very much aware of the lack of understanding and rapport between flying personnel and medical men. Some of the difficulty can be attributed to a lack of effective contact between the two groups. One flight surgeon recently discussed this problem at length in a letter which was passed along to the Naval Aviation Safety Center.

"At every medical facility where flight surgeons are stationed," he wrote, "one of them at the very least should have as a primary duty the responsibility to be in the squadron areas daily in order to get to know its personnel from skipper on down as well as possible. He should be, if at all possible, someone who likes to fly and he should be encouraged to do so at every opportunity. It is amazing to me what effect just the expression of a desire to go up with these people has upon them. Wherever possible when medical problems come up among the pilots, this flight surgeon should be the first person approached.

"Often instructors want to discuss students with a flight surgeon, which is very good, but at every station I have been this has been difficult to do. The flight surgeon is tied down in the dispensary, the instructor is tied down at his squadron, and even if the 'Doc' were available, as it is, his experience with what the squadron does is so slight that he might have difficulty comprehending the problem once presented with it. . . . Some one of us at every air station should make himself a part of the flying community. The pilots need us, they want us, and really there are no other reasons for our being in existence as a group of physicians set apart by special desig-

Utilization of available flight surgeons' time poses a problem for all hands. NASC is fully aware of the many conflicts—but hopes that publicity, however controversial in nature, may serve to help resolve these in the interests of safety.

Shift

nation."

In civilian or military life, small problems, easy to discuss with the boss face-to-face, are rarely taken to him through formal, time-consuming channels. This is also true of aviation personnel with minor ailments. Down at the hangar or at the club, a pilot will tell a flight surgeon about medical problems he would never bother to take to sick call. And minor ailments can sometimes be symptoms of more serious conditions. Who can say what the course of events might have been if a flight surgeon had observed the extreme fatigue of a pilot who crashed after takeoff last year and had grounded him before the flight. The cause of the accident was ruled "undetermined with pilot incapacitation and pilot as the most probable contributing factors." After weighing the autopsy findings, medical personnel were of the opinion that the pilot was completely incapacitated due to coronary insufficiency and resulting pain immediately after the aircraft had become airborne. He had not been to sick call for eight months.

A sharp-eyed flight surgeon can sometimes correct faulty and unsafe maintenance procedures. Take the recent case in which a maintenance man lost consciousness from inhaling JP-4 fumes in an aircraft fuel cell. An alert flight surgeon on the line possibly could have prevented this incident by noting and correcting the man's failure to wear protective breathing apparatus and use a safety line.

On the positive side, we have, for instance, the flight surgeon who grounded two pilots aboard ship before an early morning special weapons flight when he observed that they were exhausted from four days work with only five hours of interrupted sleep a night. The skipper called off the exercise, the pilots went back to bed and there was no accident . . . and then there is the instance reported in squadron safety council minutes . . . the flight surgeon discovered a man working on the line who had no depth perception. The maintenance officer removed the man from the line immediately.

Granted, proving that an accident that didn't happen was prevented is impossible and hindsight is a great deal easier than foresight. However, the fact remains, *flight surgeons are not going to prevent many accidents in the field by having to sit behind their desks.* Getting out in the field will call for persistent effort on the part of junior flight surgeons and cooperation from senior medical officers who may, in their zeal to take care of dependents' sick call, lose sight of how important it is for flight surgeons to work closely with their squadrons. In view of the obvious shortage of medical officers in the Navy and the tremendous patient loads carried by station dispensaries, this will not be easy but the objectives are improved operational readiness and improved aviation safety.

A flight surgeon must be part of his squadron or group in spirit and activities as well as by billet. In order to know the men of his squadron, to understand their problems and to win their confidence, he must share their work, their troubles and their recreation, and above all, *he must fly with them.* ●


When Trouble Comes Your Anti-G Suit Can Give You That EXTRA MARGIN!

G FORCES and the Anti-G Suit

By J. A. Bristow

The most perfect escape system in the world won't do you any good if you have passed out when the time comes to pull the face curtain or firing handle and GO. Cost-free, high probability insurance that this won't happen to you is your anti-G suit, properly fitted, worn *and* connected.

A disturbingly large number of accident reports coming into the Naval Aviation Safety Center indicate that in many instances pilots are *not* wearing their anti-G Suits as required. In other cases, they are wearing them but do not have them connected. The reason most often indicated on the reports is "Not considered necessary for this flight."

Don't fool yourself with the rationalization that the mission is going to be normal and routine. Peacetime missions are *all* intended to be normal and routine. But what happens if after that uneventful preflight and takeoff you encounter unexpected turbulence, an inadvertent spin, airframe failure or a control malfunction?

When trouble comes, your anti-G suit can give you that extra margin. It can keep you conscious to regain control of your aircraft or to actuate your escape system when, without the protection of the suit, you might have blacked out.

Without an anti-G suit, the average pilot in good condition can withstand 4.0 to 5.5 positive Gs without losing vision or blacking out. *With* an anti-G suit, the average pilot is capable of withstanding increased G loads—even up to 6 or 7 Gs. This protection is for sustained accelerations of 4 to 5 seconds or longer in maneuvers other than snap maneuvers.

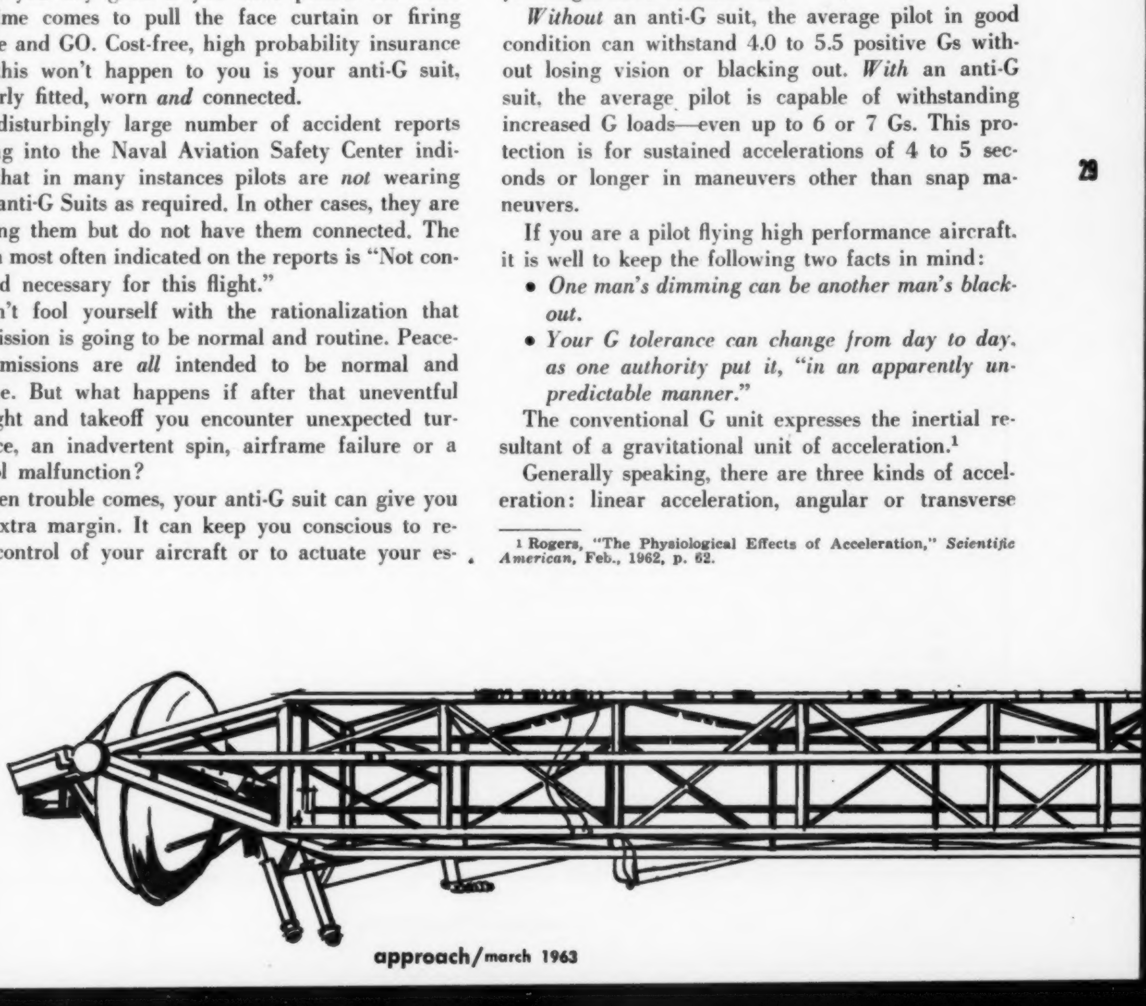
If you are a pilot flying high performance aircraft, it is well to keep the following two facts in mind:

- *One man's dimming can be another man's blackout.*
- *Your G tolerance can change from day to day, as one authority put it, "in an apparently unpredictable manner."*

The conventional G unit expresses the inertial resultant of a gravitational unit of acceleration.[1]

Generally speaking, there are three kinds of acceleration: linear acceleration, angular or transverse

[1] Rogers, "The Physiological Effects of Acceleration," *Scientific American*, Feb., 1962, p. 62.



acceleration and radial acceleration. Although accelerative forces usually act in combination, for the purposes of this discussion of G forces and the aviator, radial acceleration is our main concern.

Radial acceleration can be positive or negative. Here we best quote a manual:[2]

> *Positive G*: When the force producing the change in direction is applied to the undersurface of the airfoil, "positive" (headward) acceleration is said to have occurred and the force of inertia (reactive force), acting on the occupant from head to feet, is expressed in positive gravitational units as "+G."
>
> *Negative G*: If the change in direction of motion of the aircraft around its horizontal transverse axis is a result of a force applied to the upper surface of the airfoil, "negative" (footward) acceleration is said to have occurred, and the force of inertia acting on the occupant's body from feet to head is expressed in negative gravitational units as "—G."

No matter whether the G forces are positive or negative, the ultimate result is unconsciousness. Positive G forces pool the blood in the abdominal region and lower legs. When the head is deprived of normal blood circulation, loss of vision results, eventually followed by unconsciousness due to oxygen starvation in the brain. Negative G forces which pool the blood in the head produce unconsciousness by stagnation of circulation.

Subjective Symptoms of G Forces

What are the subjective symptoms of positive and negative G? How do positive and negative G forces make a pilot feel?[3]

Positive G, as described earlier, is the force normally experienced by the body from the pull of gravity in the upright position. Under 2 positive Gs, you become aware of increased pressure of the body on the seat and heaviness of your hands and feet. If you weigh 200 lbs., under 2 Gs you weigh 400 lbs.

Under 3 to 4 positive Gs the sensation of heaviness of the body and limbs increases. You can move your arms and legs only with great effort. Your skeletal muscles involuntarily become tense. Unless you are well-supported or maintained in a line parallel to the line of force, it is difficult to hold yourself erect. Except for limited movements of the arms and head,

[2] *USAF Flight Surgeon's Manual*, p. 71.

[3] APPROACH is indebted to Armstrong's *Principles and Practice of Aviation Medicine* (1952) for much of the following material.

Monstrous Thunderstorm

THIS fighter pilot encountered "a monstrous thunderstorm" on what was to be a routine local acceptance hop—proof that wearing your anti-G suit "just in case" makes good sense.

Flight toward the test area was without incident until the pilot, at an altitude of 40,000′ noted numerous thunderstorms below him and what he described as a "monstrous" storm ahead. The aircraft was topping thunderstorms by about 3000′ and climbing at 180 knots IAS. Airspeed dropped as he began a left bank to avoid the storm and in adding power a compressor stall ensued. The engine was shut down due to the severity of the stall. He then leveled the wings, and pushed the nose over. With the ram air turbine out and turned ON, he checked instruments. Looking up ahead he saw he was in a "blind canyon of thunderstorms."

The plane entered the thunderstorm at 38,000′. In pilot's words, "The ride from then on was practically indescribable." Although at that time he had full mental and physical faculties, he experienced extreme buffeting in the cockpit to the point of being unable to throw switches. Almost complete darkness was present except for flashes of lightning. Wings level position was impossible to maintain as he rolled from side to side through an estimated 120° of roll and the attitude pitched from 0° to 30° nose-down. A flash of lightning knocked him out with a sensation of electricity going from one hand to the other as if he had grabbed a hot electrical wire. Recovering consciousness, he looked at the altimeter and saw that the aircraft was passing through 12,000 feet.

"In panic, thinking I had to get out of this and for some reason I'll never know, I reached up and ejected the canopy," he recalls. "With the same motion I reached for the face curtain. The wind must have brought me back to my senses as I hesitated with my hand on the curtain and remembered the story of the fellow who bailed out in a thunderstorm. I thought if I bailed out here I wouldn't be any better off so why not ride it down farther. With one hand on the stick and the other on the curtain, I broke out of the side of the storm at 8000 feet. The rest of the trip home was uneventful."

Besides lightning and hail damage, damage to the aircraft resulted from high positive and negative G loading. The G meter read from – 5 to + 7. *The pilot was wearing and using a Z-3 cutaway anti-G suit.*

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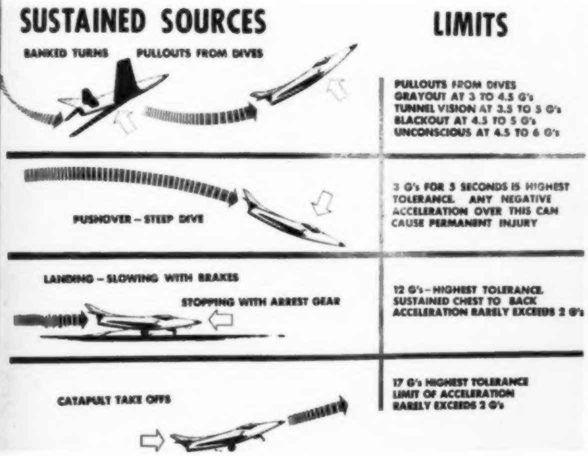
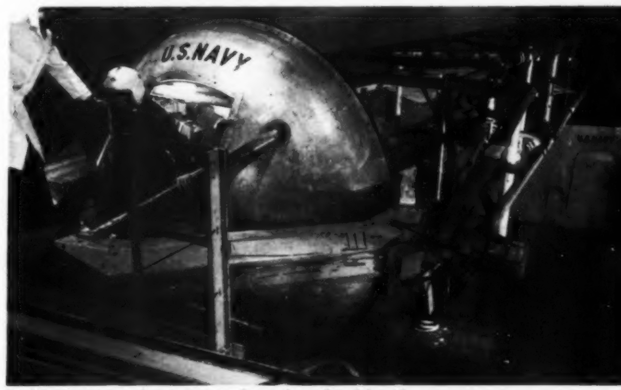
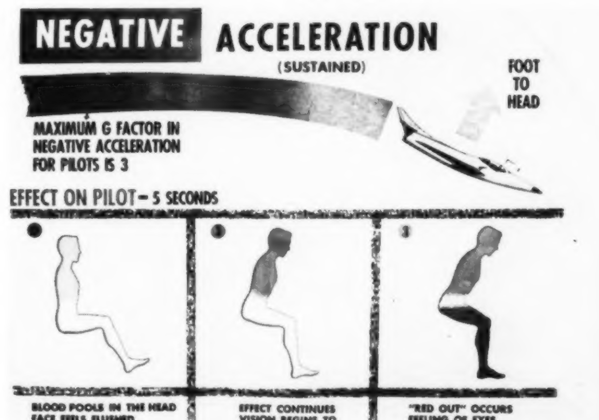
Pilot's face at normal 1 G

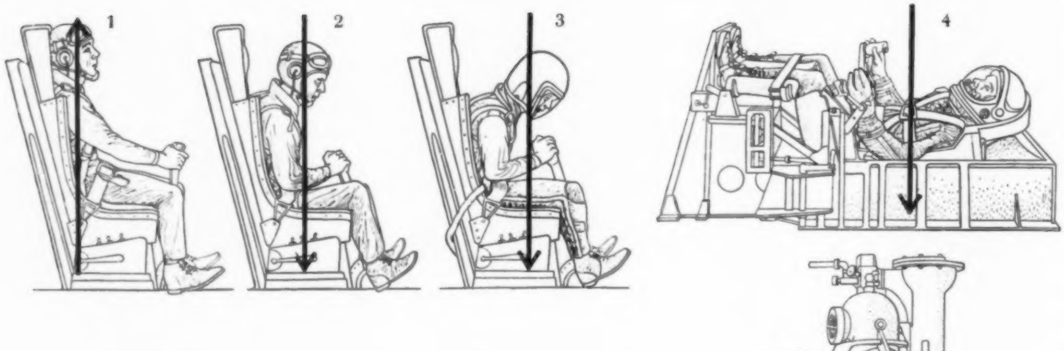




Both aviators and astronauts have benefited by the opportunities for clinical study of G forces made possible by the Navy's centrifuge at the Aviation Acceleration Laboratory, Johnsville, Pa.



Pilot's face at 10 G



TOLERANCE to sustained acceleration varies with conditions. An unprotected pilot can withstand three negative G (1) and five positive G (2) before experiencing "redout" and "blackout" respectively. A laced G suit (3) increases his tolerance to about six positive G. The Mercury couch (4) enabled the U. S. astronauts to withstand 11 G for brief periods. Tolerance in the "eyeballs in" position (5) is about eight G; in the "eyeballs out" position (6) it is greater, but a flow of tears begins to interfere with vision at eight G. The greatest G tolerance was shown by a test subject in a water-filled "iron maiden" (7), who withstood 32 positive G for five seconds. *(Scientific American)*

Blackout

In a recent fatal crash during the execution of a medium angle loft maneuver, investigation led to the conclusion that G forces were a factor in the accident. Although the pilot was wearing a Z-3 cutaway suit, investigators thought it was unlikely that he had connected it.

The pilot had previously stated to friends that he did not need or use his anti-G suit during acrobatic maneuvers. The investigating flight surgeon states that specifically he did not use it in the ½ Cuban 8 (a maneuver comparable to the loft maneuver in which 4½ positive Gs are experienced for approximately 5 seconds and then gradually diminishing Gs for another 5 seconds).

The pilot had done two maneuvers completely and had just completed his third prolonged pull-up when the stall and fatal spin occurred.

your body is almost beyond the control of your muscles. You become progressively more helpless physically. Here is where your anti-G suit can help keep your functioning and on top of the situation.

At 3 to 4 Gs there is a distinct dragging sensation in the thorax. The lower facial area feels pulled down and as blood pressure falls, there is a distinct diminuation of vision ("veiling," "grayout" or "tunnel vision") or the complete loss of vision commonly known as "blacking out." The lower parts of your legs feel congested and your calf muscles may cramp. Breathing in becomes difficult and as a defense against forced expiration, the glottis is closed voluntarily and the breath is held in mid-inspiration.

Depending on individual tolerances, loss of consciousness appears between 3 and 5 positive Gs.

As the acceleration is decreased, consciousness returns quickly followed by a return of vision. There

are seldom any lasting aftereffects except several moments of mental confusion.

Under the force of 1 negative G, you feel as if you are hanging head downward—there is a moderate upward displacement of the organs in the abdomen and a moderate congestion of the face.

Between 2 and 3 negative Gs, the face feels highly congested and there is a throbbing pain throughout the head. The congested feeling of the face becomes intense. At this point, there is a sensation of greatly increased intracranial pressure—the skull feels as if it is about to burst. The eyes feel protruding; the lids feel gritty and usually water excessively. Occasionally there is a temporary loss of vision and there have been reports that objects appear red and produce the phenomenon commonly referred to as "redding out."

Wear and Connect Suit

According to the dictates of common sense, the day-to-day variation of G forces in aviators clearly indicates the need to *wear and connect* the anti-G suit in high performance aircraft. This is also required by OpNav Inst 3710.7A:

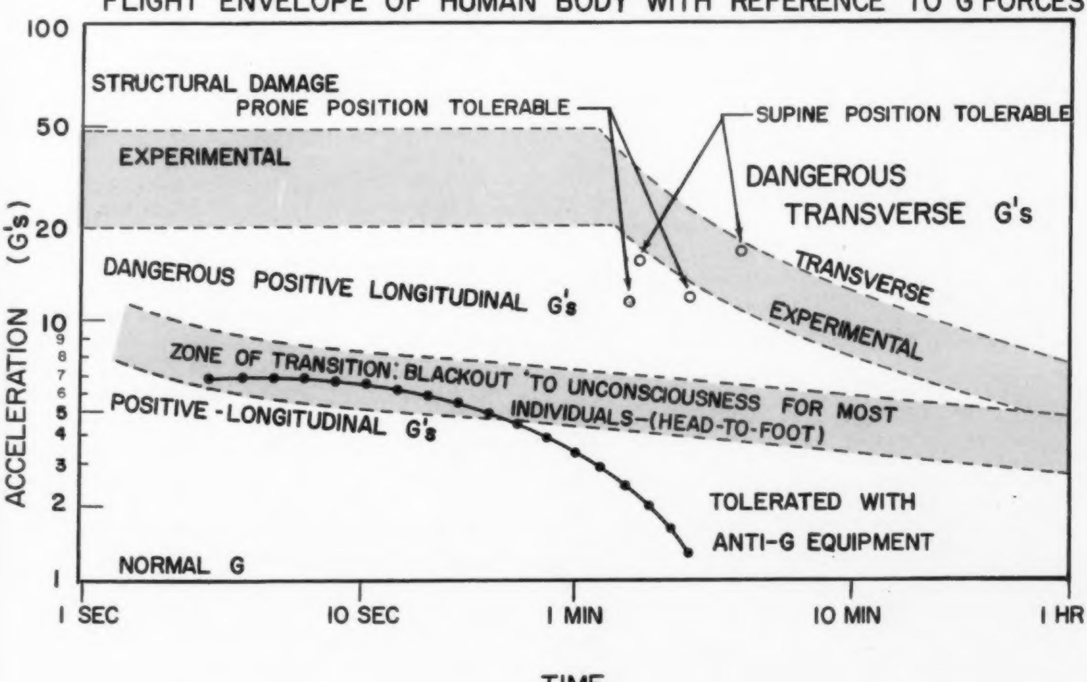
> "Anti-blackout suits shall be worn and connected in aircraft equipped for their use on all gunnery, dive-bombing, rocket, strafing, simulated combat and acrobatic flights and on all other flights where high G forces may be encountered."

Consider the facts:

As stated earlier, without the anti-G suit, the average pilot may withstand 4.0 to 5.5 positive Gs without losing vision or blacking out. *With* anti-G coveralls, the average pilot is capable of withstanding increased G loads even up to 6.0 to 7.0 positive Gs. (Again, this protection is available only for sustained accelerations of 4 to 5 seconds or longer in maneuvers other than snap maneuvers. Snap maneuvers are a separate subject when it comes to G forces. Although they rarely cause physiological symptoms due to accelerative forces, they introduce the hazard of overstressing the aircraft. A pilot accustomed to using "grayout" as an index of G may be misled by the absence of symptoms during a snap maneuver and may exceed the structural safety factors of the aircraft. Many pilots use the coverall inflation pressure of their anti-G suits as an indication of snap G.)

An anti-G suit can be a great protection to a pilot

"FLIGHT" ENVELOPE OF HUMAN BODY WITH REFERENCE TO G FORCES



Physiological Effects of Acceleration Forces

(without anti-G protection)

1 G—
Normal G (32.2 feet/second^2)

2 G's—
Hands and feet heavy: movement restricted

3 G's—
Heaviness of body and limbs increases; soft tissues sag

4 G's—
Movement only with great effort

5 G's—
Only slight movements of arms and head possible

Physiological Effects of Positive G (Head to Foot), Short Exposure Time

Peripheral Vision Decreases, Grayout	2.5—7.0 G's
Blackout	3.5—8.0 G's
Confusion, Loss of Consciousness, Depending on Personal Tolerance	4.0—8.5 G's
Anatomical Structural Damage — Spinal Injury	18—23 G's

Physiological Effects of Transverse G (Back to Chest, Chest to Back*) Short Exposure Time

No Visual Impairment or Loss of Consciousness	0—17 G's
Tolerated by Man	28—30 G's
Anatomical Structural Damage	30—45 G's

*Arrestments, cat shots

familiarizing himself with high performance aircraft, especially in the early stages of operational and gunnery training in fleet type aircraft. Without anti-G protection, a pilot who is learning and is less skilled than he will be later, may miscalculate and pull excessive G long enough to cause blackout or unconsciousness.

Other Benefits of Suit

Besides the anti-G suit's primary purpose of providing protection against grayout, blackout and unconsciousness, the suit has a number of other benefits:

- *It alleviates fatigue and decreased mental alertness which can result from repeated accelerations below the blackout level.*
- *It gives pilots a means of relieving leg stiffness and physical tension during flight. (The coveralls can be inflated manually from time to time to relieve venous congestion of the legs and stiffness and tension of the body by a massaging effect of the inflating bladders.)*
- *It provides the pilot with an indication of the acceleration to which the plane is being subjected.*
- *It can be used as accessory flotation gear when inflated orally (per BACSEB 61-61), though it is not intended to take the place of the life vest.*
- *It provides added flash burn protection.*

Suits currently furnished the fleet are the Z-2 for full garment anti-G coverall and three cutaway suits: the Z-3, the Z-4 used with the anti-exposure suit, and the modified Z-3 used with the full pressure suit. The Z-2 is available in 11 sizes; the three cutaway suits come in four sizes.

These anti-G coveralls can increase the G tolerance of the wearer by 1 to 2 + Gs depending on the fitting and whether the HI or LO setting on the G-valve is used. *Proper fit is important.* The coveralls should fit snugly but should not be too tight for comfort, especially at the waist. BACSEB 61-61 suggests that the aviator who wants to test his suit's fit sit in the plane and inflate the coveralls orally. The bladders should compress the waist, calves and thighs firmly and evenly.

Heat, Sunburn and G Tolerance

G tolerance can be influenced by temperature effects. A Mayo Clinic group studied G tolerance in a cool environment (average: 63°F., 72% relative humidity) contrasted with that obtained in the same subjects in a warm humid environment (average: 98°F., 77% relative humidity) and found that in the warmer environment, the overall G tolerance was lower on the average by 0.8 G. U. S. Navy studies at Pensacola show that sunburn has similar adverse effects on G tolerance.

—*Aerospace Medicine*, p. 250. Armstrong

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NOTES FROM YOUR FLIGHT SURGEON

Hot Suit

TWO crash fire fighters wearing aluminized asbestos suits were landed by a rescue helicopter approximately ½ mile from the crash site of an aircraft. The temperature in the dense pine and palmetto thicket was near 90°. One of the men died of heat exhaustion; he was found 300 yards from the crash site and 500 yards from his original starting point two hours after the SAR helo had launched. The second man suffered exhaustion, became unconscious and after regaining consciousness did not reach the site until some two hours after the crash.

All personnel involved in this sort of operation should be aware of the possibility of heat exhaustion while wearing crash fire-fighting protective clothing for great lengths of time in areas of high temperature and humidity. Because of the clothing's heavy insulation and extremely limited ventilation, heat exhaustion can occur in a short time in hot weather when the wearer is very active physically.

Training, Inspection

AS AVIATION has progressed, new devices for the protection of pilots have been invented and old ones improved upon. Any improvement however, is wasted if the pilot doesn't use it.

Locking the shoulder harness for landing, and the canopy open for a crash landing, are very basic precautions, but they will be reemphasized to all local area pilots. The flight surgeon has been directed to inspect the flight gear of all pilots when they first check in to the facility and again every year when they receive their flight physical. It is hoped that such emphasis on ascertaining that the pilots have proper survival gear will make them more likely to heed pleas to use it.—*First Endorsement to an AAR*

Marker Injures Man

TWO aviation ordnancemen were performing work on a marine marker ejector (Aero 1B) installed in an S-2 (S2F). After adjustment of a solenoid, a Mk-7 marine marker was injected into the barrel. It was determined that additional maintenance was required; the retro was removed and another retro was installed by a third ordnanceman. After the installation was completed, the man began a functional check. In spite of a visual check of the barrel and a hand check of the chamber, they failed to detect the marine marker. When the retro was fired, the marker was ejected at a velocity setting of 90 knots. It struck and seriously injured a man more than 200 feet away.

Fuel Fumes

A MECHANIC working inside the aft fuel cell of an A-3 (A3D) passed out from JP-4 fumes. The cell had 14" of JP-4 in one end and had been closed for two days. The mechanic was wearing normal working clothes and did not have any type of breathing apparatus or safety line.

Rescuers were themselves unable to stand the fumes. One of the men equipped with a mask and air hose went in and secured a line around the victim's chest. He was then hauled out. He had been in the cell some 10 to 15 minutes, the last part of which he was lying unconscious, face down in the fuel. Emergency medical treatment saved his life though he was hospitalized for about one month.

This accident points out the need for adequate safety training for ground personnel, the reporting medical officer stated. It indicates a glaring absence of supervision. Entry of personnel into fuel cells should be in compliance with BuWeps Instruction 10345.1A.

No Protection

PERSONNEL without ear plugs or head sets have been observed around jet aircraft being turned up. It must be reemphasized that personnel who disregard these safety instructions may suffer loss of hearing to various degrees.

—*Safety Council Minutes*

Habit Interference?

THE pilot was able to fire only four tracer rounds from the revolver due to his inability to reload correctly. On questioning, he related that rather than clear the chamber as is correct he attempted to open the revolver in the same manner he opens his .22 caliber revolver at home. The flight surgeon felt that in the stress of the survival episode the most learned habit prevailed, thus interfering with the procedure necessary to reload the .38 cal revolver.

(Or was this a lack of training? —Ed.)

Line-level Helicopter Maintenance

by **ROBERT J. MYER**

The Kaman Aircraft Corp

Reprinted from "Aerospace Accident and Maintenance Review"

UNLIKE ROUTINE maintenance, the prime considerations in the non-routine category are more specifically influenced by their application to helicopters. The basic requirements of good aircraft maintenance practices and quality control still apply, but a greater understanding of the theory of operation and criticalness of helicopter components is necessary to avoid inadvertent malpractice.

Trouble-Shooting

This area of non-routine line-level maintenance is as subjective as it is intangible. Although, like the other aspects of aircraft maintenance, the fundamentals of specific systems, components, or types of components can be taught, significant levels of achievement in trouble-shooting usually come only after long periods of firsthand experience. The following points and recommendations will, therefore, be limited to the approach rather than detailed procedures on any specific component or system:

1. Consider the problem. Most problems can be classified as to *nature* and *type*. By "nature" we mean operational malfunctions, roughness, noise, etc. By "type" we mean mechanical, electrical, aerodynamic, etc. Obviously a given problem can encompass one or more conditions in both groups, but by considering these points we start our deduction processes and usually arrive at a logical approach. If the problem is simple or a report of previously experienced conditions, we can usually estab-

lish the method of analysis and pinpoint the malfunction in a minimum of time.

2. Detailed analysis is required when the problem is more complex. Before haphazardly plunging into the mechanics of the first suspected item or area, review all related trouble histories, aircraft and component records, pilots' reports, reports relating to component changes or maintenance recently accomplished, etc. This practice will usually not only save time and effort (provided adequate records are maintained), but it will avoid unnecessary operation of malfunctioning equipment which could possibly lead to additional damage or personal injury.

3. Take one corrective action at a time. Although it is seldom considered in the haste to correct a problem and get an aircraft in operational status, the secondary benefit of gaining important experience can be of more lasting value than the quickly achieved fix. By taking one corrective action at a time, you can ultimately pinpoint the problem area and store away the knowledge for a quicker, less costly solution in the future.

4. When flight performance concerns are being analyzed and all safety of flight aspects have been thoroughly reviewed and provided for, a well-planned, appropriately cautious flight evaluation is in order.

In order to successfully trouble-shoot helicopter inflight performance or roughness problems, both the principles of general helicopter operation and those of the specific type involved must be thoroughly understood. The easiest illustration of this type is roughness. When this condition is reported, the first thing to be determined is the approximate frequency. Lower frequency vibrations (below 300/min) are usually the result of a problem in the lower speed rotor system, while higher frequency vibrations (well above 1000/min) are usually the result of a problem in the higher speed drive system. Rotor system roughness can be attributed to dynamic imbalance or a mechanical malfunction or failure. If the helicopter previously operated satisfactorily with the same components installed, dynamic imbalance in either system is unlikely or the fault should be relatively obvious, i.e., a portion of one of the components would have had to come off. Assuming that this did not happen and that the roughness was of a low-frequency nature, it is logical to deduce that it is caused by a rotor blade aerodynamic imbalance or a mechanical malfunction or failure somewhere in the rotor system. A thorough inspection of the rotor system is in order, not only to determine that a mechanical malfunction is not the cause of the problem, but also to insure that the rotor system is safe to turn up for further evaluation. If such is the case, the rotor turnup would very likely substantiate an aerodynamic imbalance as indicated by an out-of-track condition.

To further complicate this analysis, the condition might vary in different operational modes. For instance, the problem may evidence itself in forward flight and not in hover. Having determined that previous operation of the blades was satisfactory and that they appear to be structurally sound, only two probable causes remain—deterioration of control linkages or a control or trimming device maladjustment. This may seem like an involved method to arrive at such a basic conclusion. You might rightly reason that had the pilot noticed a significant blade out-of-track condition when the roughness occurred, the controls or trimming device could be readjusted and the problem resolved forthwith. The fallacy in such an approach is the possibility that the problem was caused by a mechanical or structural discrepancy. Temporary relief might be obtained by the superficial adjustment, only to result in a catastrophic failure during subsequent operation.

The above illustration is presented as an example of the type of trouble-shooting problems and analyses peculiar to helicopter operation. The general nature of this article does not permit further discussion of this point; however, application of these recommendations with reasonable judgment and experience should minimize the problem of analyzing similar problems.

Adjustments and Rigging

A thorough understanding of the theory of operation of a device is most helpful before attempting to adjust or rig it. Unfortunately, human nature being what it is, most of us dislike spending the required time to study related manuals or instructions, even though experience has proved that much time would be saved and frustration avoided by so doing. When the object being worked on is an aircraft or component, the element of safety is even of greater consequence, especially if the aircraft is a helicopter.

The helicopter systems most related to performance and subject to adjustment and rigging are the flight controls, rotors, and power plant controls. The lower or non-rotating flight controls are similar to their fixed-wing counterparts in that they are set to specific throws and neutral positions. Variation from these criteria can result in insufficient travel or binding, incorrect relationship in the functioning between two or more interlinked systems, uncomfortable stick and pedal flight positions, roughness, and noises.

The interdependence of the upper or rotating control system and the rotors is such that they are best discussed together. These systems govern the output control and blade tip path track of the rotors which are directly related to helicopter performance. Helicopter power plant control rigging, especially when turbine engines are involved, is quite critical. Idling settings must be low enough to permit rotor disengagement and high enough to insure against inadvertent cutout or flameout. The proper ratio of power control with changes in collective settings must be attained as well as adequate power throughout the entire flight regime to meet performance requirements.

Misrigging or maladjustment of upper helicopter controls or rotors can result in roughness from blades being out of track; insufficient control, which can result in a flight safety concern; incorrect autorotation rpm; and generally poor flight performance. Misrigging or maladjustment of power plant controls as indicated earlier can result in cutting-out or inadequate power. In addition, especially as related to turbine engines, improper settings can cause overtemps or overspeeds which require premature engine replacement.

Inasmuch as rotor blade tracking is one of the more common line-level rigging and adjustment requirements peculiar to helicopter operations, let's consider the subject at this point.

Electronic blade tracking converts light beam interruptions into vertical height differential.

Helicopter rotor blade tracking is somewhat controversial in the military and industry, especially as related to the method to be employed. As with fixed-wing aircraft propellers, the basic requirement is a reference point against which the path of different blades can be measured. Because of the possible aerodynamic variations, it is necessary to track helicopter rotor blades while they are turning at specified operational speeds, usually at the low collective pitch setting. This requires the utmost caution and proper supervision experience when the tracking reference device used is the commonly known *tracking flag*. The degree of concern varies with the condition of the surface on which the job is being performed, the size and height of the rotor blades, and the prevailing wind conditions. The respective manufacturers instructions should be thoroughly understood and followed. A few general recommendations are:

1. Have a qualified test pilot or a highly experienced pilot in the respective model aircraft at the controls.

2. Apply contrasting color grease pencil or chalk to the blade tips.

3. The mechanic should consider direction of blade rotation and position himself so that he is generally facing the direction of the blade tip path rotation. In the event of loss of flag control, it will then be carried away from the mechanic's body.

4. Adjust the flag to have mid-point of the material at the approximate height of blade tip path as specified operational speeds and collective control inputs.

5. Get a signal from the pilot when ready to track.

6. Approach the helicopter with the top of the flag at sufficient outboard angle to insure against premature blade contact.

7. Select resting point of flag staff at a spot on the ground just outside of blade tip path and attain a comfortable stance.

8. Hold flag material either in line with radius of rotation or slightly canted with direction of blade rotation to get better indications; avoid tearing material, and reduce possibility of loss of flag control with excessive engagement.

9. Slowly and steadily move top of flag toward blade tips, pivoting about lower end resting on pre-selected point on the ground until contact is made with all blade tips. Attempt to get only one contact per blade to avoid conflicting marks.

10. Withdraw flag and check the marks.

11. It is sometimes desirable, especially when tracking high rotors, to have a second man stationed some distance forward of and facing the man holding the flag to help judge and insure that the flag height is correct.

12. Direction and extent of adjustment is usually available in the respective model maintenance directive.

Other methods of helicopter rotor blade tracking are: (a) flag unit attached to pivot point on aircraft structure to accommodate extremely large models, (b) a brush on the end of a pole to transfer marking substance to the lower blade (primarily suited for two-bladed rotors), (c) visual (this method requires experienced personnel and is used on two-bladed rotors having contrasting color tips), (d) electronic devices that convert light beam interruptions or capacitance variations into vertical height differential.

In the case of the light beam system, an indexing device must be secured to the rotor shaft to establish a reference blade. This is provided as a built-in feature on some models. Another feature provided on Kaman helicopters is inflight tracking systems which can also be used to facilitate initial ground track.

Tail rotor tracking may or may not be required, depending on the model. Special procedures and devices are usually provided when tracking is required. Most of the above noted main rotor recommendations apply, especially those related with flag-to-blade tip contact. The requirement for caution is amplified by the higher tail rotor speeds and usually lower ground clearance.

Rigging

Proper rigging and adjustment is essential for better performance. Better performance not only benefits the operator by providing good flying characteristics, but it also reduces abnormal loads and out-of-limit conditions and brings on a reduction in maintenance. These benefits are obtained by a thorough understanding of the theory of operation and mechanism of the component being adjusted or rigged; by close adherence to instructions provided in applicable manuals; and cooperation between mechanic and pilot.

On the practical side, a reminder is in order to insure that all connections are properly secured and safetied after adjustments are made. Because of the obscure locations of some parts of control systems and power plant installations, this is an item that is easily overlooked and can have dire results.

For those who question this subject as a category of non-routine maintenance, it is agreed that, like component replacements, it could easily fall under routine maintenance, depending upon the circumstances. The non-routine category was determined as the better choice, inasmuch as much rigging and adjustment is accomplished as a result of operational squawks. This brings us to a final word of caution. Once a component is properly adjusted, including those making up such a complex machine as a helicopter, major changes are highly unlikely. Performance does vary as a result of atmospheric environment changes and is to be expected and corrected as required. Minor changes also develop as a result of linkage wear, blade finish condition, and power plant age. There are also occasional differences of opinion between helicopter drivers which require pacification. However, *repetitive changes, especially in the same direction, can be a warning of impending failure!* Such a condition should be thoroughly analyzed before additional adjustments and operation are permitted.

Limited Repair and Changes

Here again a thorough understanding and appreciation of the function and operation of the respective helicopter components is essential to avoid incorrect treatment. The basic structure—fuel and oil systems, electrical systems, instruments, and fixed equipment—is very similar to the fixed-wing equivalents and most of the same aircraft maintenance and repair rules apply.

Structural attachment points for drive system components are somewhat more critical because of normal rotor vibration, imposed stresses, and suspension loads. Control system cables, rods, and links are similar but, depending on the location and type of helicopter, loads may be significantly greater than in related fixed-wing components. This is especially true in the upper control system which is subjected to continuous cyclical operation and, in many cases, centrifugal forces. Drive system components, though apparently similar to fixed-wing power plant nose sections, are also subjected to quite different loads and perform more vital functions. Main transmission shafts not only carry the high torsional lift loads, but are continually subjected to varying cyclical bending loads imposed by the rotor plane, depending on the control applied. In tail rotor installations, directional control obviously depends on the integrity of associated gear boxes and shafting. Failure of a propeller shaft, even on a single-engine, fixed-wing aircraft, does not necessarily mean catastrophe if a suitable landing area is available in an emergency. Conversely, failure on the output side of a helicopter main transmission, in the rotor retention system, or any place in the tail rotor drive system usually results in major damage. And lastly, to complete the examples of the differences between fixed-wing aircraft and helicopters, we come to that unique component—the rotor blade. Many elementary aerodynamic books compare rotor blade lift to that produced by aircraft wings. This is where the major similarity ends. Although certain

Aboard or ashore, effective chopper maintenance requires technicians with a good knowledge of theory of operation.

aspects of some rotor blade construction resemble aircraft wing construction, the high centrifugal whirling loads and continuous flapping loads require significantly different structural design and repair considerations.

The point of this comparison is to have maintenance personnel develop an awareness of the importance of the various helicopter components and treat them accordingly. Some specific guidelines relative to helicopter repair are:

• Follow the book. By this is meant the specific component or model manuals as well as the general repair guides. No one is better qualified to establish critical repair limitations than the designer and manufacturer.

• Use care in handling components such as those mentioned above. Dents, gouges, or abrasions made by inadvertent slips with tools, or scribe lines made by sharp instruments in critical areas, can be the nucleus of a fatigue-generated failure. Many highly stressed components are being shot-peened to lessen their susceptibility to fatigue. Arbitrary defacing or even careful smoothing out of defects in this finish, which is only .002- to .003-inch deep, can not only undo the benefits of the finish, but create stress risers as well.

• Pay close attention to the security of doors, panels, or any components that could become detached in flight and end up entangled in the main or tail rotor systems. Insure that related fasteners are properly installed and, where specified, properly safetied. Whenever possible, adhere to the long-established requirement to have bolt heads positioned up, forward, or inboard.

• Take extreme care in replacing bearings and rod ends to avoid contamination or damage from incorrect installation or removal practices. One very vulnerable area is the replacement of hollow shank rod ends riveted to solid or tubular control rods. Unless the old rivet holes in the control rod are accurately transferred to the rod end shank, hidden elongation and weakness can result. One method of accomplishing this transfer is to locate the control rod hole under a drill head and clamp the control rod to the drill table. When the rod end shank is slipped on and drilled in place, a true-hole transfer will be accomplished.

• Use the specified material. This applies to standard hardware as well as raw material. It used to be that an AN bolt was an AN bolt and if it fit the hole, it was good enough—but not any more! Weight and space considerations are forcing the use of increasingly sophisticated materials. The structural integrity of the unit is based on the use of the materials specified. Unauthorized substitutions are strictly taboo!

• Adhere closely to corrosion preventive practices such as the use of specified dielectric materials between dissimilar metals, application of specified finishes, and elimination, where possible, of moisture traps. The severity of this concern obviously depends on the environment. However, because of the extensive use of magnesium and aluminum in most helicopters, corrosion problems can be expected if they operate anywhere near salt atmosphere. The problem is naturally most severe when missions require operation at low altitudes over open bodies of salt water, since the turbulance created by the rotors causes salt spray to permeate every opening and crevice.

On the subject of change incorporation, it often takes the same understanding of component function to know what minor deviations are permissible. This point is raised because of the numerous problem reports received from field activities when some part of a change kit does not exactly fit the respective part of the aircraft. Most manufacturers face this problem as a result of the continuing design changes that are incorporated into aircraft at different production phases. When a field retroactive change is conceived, much consideration is given to the various configurations delivered; but sometimes we miss, or the variations are such that it is not practical to cover them all. In such instances the related bulletin usually indicates that the kit should be installed to achieve the intent of the change, thereby authorizing the required installation variations.

Another item pertaining to changes, only remotely related to the practical aspects of repair and change incorporation, is offered here. This is the means by which a desired change can be brought about. Numerous suggestions or requests for changes are received via contractors' representatives or during other informal discussions with using-agency personnel. As a result, letters are sent by the contractor to the appropriate procuring agency office, requesting permission to submit these changes. Unless the changes offered resolve a potential safety-of-flight concern, correct a formal UR project, or are utterly irresistible in other respects, the answer is usually, "No, thanks, we have received no formal requirement for this change from our operating units." The procuring agencies must take this position to insure that available dollars cover necessary areas of support, reduce unnecessary maintenance manhour expenditure that would otherwise be required to incorporate these changes, and reduce the aircraft downtime that such incorporation of excessive changes would create. In summary, if you want to implement a change in a weapon system which does not remedy a safety-of-flight condition or correct a significant UR concern, it must have formal operational justification and support. The days of casual approval of improvement-type changes are over.

General

Helicopter maintenance, like the care and feeding of every item of Air Force equipment, is most effective when coupled with the trained mind and skilled hands of the true professional. The maintenance technician is one in a long chain of men, from the theoretical physicist who puts the system on paper and believes that it will work, to the operator who puts the system in the air and proves that it will. But it will work only when everyman along the way puts the best that he has into everything that he does. ■

MURPHY'S LAW*

* If an aircraft part can be installed incorrectly, someone will install it that way!

Like most helos the SH-34J (HSS-1N) now and then requires tail rotor balancing. Often replacement is involved. Tail rotor blades must then be uncrated and assembled to the hub for balancing.

In this particular case, when reassembling the tail rotor blades to the tail rotor hub a slight (?) mistake was made . . . the tail rotor blades, all four, were installed backwards. During the balancing and rerigging of the tail rotor assembly nothing appeared to be wrong. The work had been checked by qualified shop personnel and no difficulty was encountered while reinstalling the assembly on the helicopter tail pylon. Everything appeared normal and checked out all right.

Later the backward blade installation was discovered by a casual observer passing through the hangar deck. Could this error have passed by the plane captain on his daily and preflight inspection and then passed by the pilot on his preflight?

It appears conceivable that this mistake could happen again. *No* difficulty is encountered in installing the tail rotor blades backward, in fact, they fit perfectly either way.

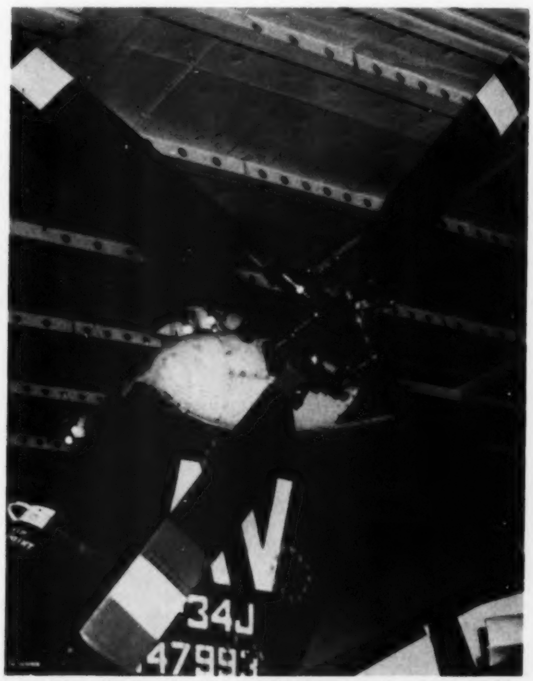
Pertinent Points:

(1) Again it must be stressed by supervisory personnel that the use of the HMI and procedures outlined therein must be followed explicitly.

(2) Quality Control should inspect carefully all work that must be checked on test flights by test pilots.

(3) It would seem that some system or design change could be incorporated that would render backward blades installation impossible, such as larger bolts and holes for one of the two bolts that secure the blade to the hub. Perhaps some type of color coding could be devised, or arrows painted on the blade hub fitting indicating proper direction of installation.—*Contributed by C. H. Knight, Aviation Safety Officer, HS-7*

Incorrect installation of tail rotor blades on tail rotor assembly.



Correct installation of tail rotor blades on tail rotor assembly.

Finding Fuel Leaks With Dye

CURRENT inquiries from the field indicate a need for information regarding the use of dye as an aid in determining the source of fuel leaks. North American Aviation, Incorporated has used a red dye known as Oil Red "O" which is readily soluble in hydrocarbons and is harmless to the engine and fuel system. The following procedure (approved by BuWeps) is based on information from NAA with slight modifications to meet the needs of the Navy.

To work efficiently with the dye, a concentrated solution in toluene must first be prepared. Dissolve 3 oz. of dye powder in one gallon of toluene at ambient temperature. Shake well or stir thoroughly until dissolved. This solution does not require decanting or filtering and may be used immediately or stored for future use by packaging in clean one-gallon rectangular cans labeled as follows:

Material: Dye, oil soluble red.

Caution: Flammable mixture—keep away from open flames

Before the dye is used to determine the source of fuel leaks, it is recommended that any leaks be eliminated in the visible portions of the tanks and connected plumbing. If it is necessary to use dye to locate a hidden leak, select a method for filling the tanks which will allow testing of only one questionable tank at a time with colored fuel.

Add dye to the suspected tank when it is one quarter full, using two quarts of stock dye solution for each 100 gallons of tank capacity. Completely fill tank with fuel after dye has been added and then wait for dye to appear in leaking fuel. A very small leak may require an hour or more for color to appear. If no dye appears after reasonable waiting period, repeat process on additional tank units until leak is found.

The dye will leave a stain which can be followed back to the source of the leak, even after the tank unit is emptied and the drippage has ceased. Do not return the colored jet fuel to bulk storage tanks or trucks, as there is sufficient dye in one quart of stock dye solution to color 20,000 gallons of fuel. The colored test fuel is suitable for use in any jet engine and dye does not have a harmful effect on the usefulness of the fuel. The amount of toluene added to the fuel by inclusion of the dye solution is insufficient to harm components of either the airplane or engine fuel systems.

Fuel from tanks tested with dye will remain colored until they have been filled and emptied several times. Stains appearing on the airplane structure from use of the dye may be wiped off the airplane with a clean rag wet with Stoddard Solvent (Specification P-S-661). The dye solution will readily color clothing, but can be removed with JP fuel or dry-cleaning solvents.

Oil Red "O" is a product of the National Aniline Division of the Allied Chemical Corporation. There is no known Federal Stock Number for this material; therefore, it will have to be purchased from one of the manufacturer's following regional offices:

6510 E. Bandini Blvd. Los Angeles 22, Cal.	42 Rector St. (Home Office) New York 6, New York
235 Montgomery St. San Francisco 5, Cal.	150 Causeway Street Boston, Massachusetts

NOTES AND COMMENTS ON MAINTENANCE

A-3 (A3D) Throttle Rigging

As the pilot advanced both throttles of his A-3A the port engine commenced turning up to full power but the starboard engine flamed out.

Not a very serious situation for the average Navy pilot flying an aircraft with the excellent single-engine performance characteristics of the A-3, but in this case the event occurred while following through on a bolter during carrier qualification refresher. The flight back to the beach, except for a jammed starboard throttle, was otherwise uneventful.

Investigation of the jammed throttle and fuel control linkage revealed a condition wherein the fuel control went to IDLE CUT-OFF when the throttle was advanced to FULL POWER. Prior to the reported discrepancy, the aircraft had flown five flights for a total of 8.8 hours since the engine installation.

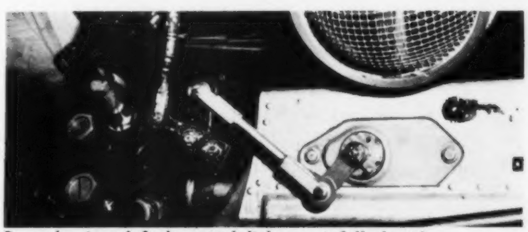
A concentrated review of the procedures for engine trimming, throttle rigging and applicable instructions pertaining thereto established that compliance with existing instructions would have in all respects prepared the engine for flight. However, the throttle and fuel control linkages could be rigged to a marginal position so as to cause the power control actuating rod and the power control lever to ride overcenter thus causing *reverse* throw on the power control actuating rod when the throttle was advanced to full power. With the throttle control in this position the fuel control lever moved to IDLE CUT-OFF, resulting in engine flameout. Proper rigging procedures had to be reviewed and reinstated to eliminate the culprit.

An A-3/J57 throttle rigging template was fabricated locally. Use of the template was to insure that all rigging settings were within the prescribed tolerances and that the additive adjustments to the linkage did not border on marginal or fringe measurements as to cause overcentering. Additional angular measurements of fuel control links not incorporated in the applicable maintenance handbooks were defined and built into the rigging template. Detailed rigging instructions, use of the template, and training of maintenance personnel have been reemphasized by this command for more positive and exacting adjustments while rigging throttles and fuel controls. The next revisions to the A-3 (all models) Handbook of Maintenance Instructions will provide further instructions and drawings of the proper procedures and measurements to be used in rigging throttles.

Marrying of throttles at certain prescribed power settings is a common source of throwing the rigging out of tolerance. Caution should be exercised when marrying throttles to insure that measurements and alignments of the rigging have not been compromised. This is not the first occurrence of the reported incident, but with adequate instructions and training let's hope it will be the last.

Contributed by LT Charles A. Allen, VAH-3

Improperly rigged fuel control linkage at full throttle position.



Properly rigged fuel control linkage at full throttle.

Fuel control linkage rigging template.

Foreign Object Damage

AIR Group Commander submitted that protection from foreign object damage is an all hands job and should be programmed. Commanding Officer HS-3 commented on a few specific cases where he found air group personnel causing foreign object hazards; he emphasized that the squadron was aware that all hands on board were susceptible to creating hazard. Flight Deck Officer re-emphasized the importance of personnel working on the flight deck not having any stray objects in their pockets, such as baseball caps, rags, handkerchiefs, . . . The Air Officer stated that a walk down the deck would be made prior to each launch to remove any nails, screws, bolts, . . . from the flight deck which might cause tire damage.

—*USS* INTREPID

"All Roads . . ."

QUALITY aircraft maintenance is an elusive thing and is measurable only in negative terms since the only gage the mechanic has is the number of failures noted by the flight crew at the end of each flight. These, in themselves, may not be expressive of maintenance quality, since these failures in equipment could have been the result of the lack of proficiency of the operator or the inherent unreliability of the equipment. Thus, neither the number nor type of malfunctions is a positive measure of the success or failure of the maintenance performed.

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There are other areas in which we can measure maintenance more accurately. Take discrepancies, both major and minor, which have been left uncorrected for long periods of time—no question of laxness here. Take the inadequacy of corrective action. Corrective action such as "ground checked OK" is the worst type. Another, where the mechanic has swapped fuel-indicating units from one tank to another in a futile attempt to correct an unsafe condition, reminds you of the gag, "Don't look at it and maybe it will go away."

These are obviously positive indications of the lack of quality maintenance. The mechanic is simply not doing his job. This points to the maintenance chief's failure to supervise and instruct adequately. Evidently the maintenance officer is accepting this kind of maintenance or is unaware of its existence. It is difficult to say which is the greater weakness. The squadron commander is affected, since his is the responsibility for quality maintenance. The chief of maintenance sets the standard for maintenance practices and has in the quality control section the eyes and ears to tell him at what level that quality is. Finally, as all roads lead to Rome, so, in the final analysis, it becomes the skipper's burden.

—*"Combat Crew"*

Tell Your Tale

FROM our occasional visits to your squadrons we hear tell of some real thrilling episodes that have livened up your maintenance days. Suspect that a few of them may have caused a few gray hairs, too.

The trouble is that too often we don't get the dope here at the Naval Aviation Safety Center while it's still "hot" so that it can be passed along. Do you maintenance people know how the Anymouse deal works? Are the forms available in the maintenance areas?

A second thought—perhaps a few minutes at the next technical training session, explaining to the troops how much help their experiences (both good and bad) can be for safety and maintenance, would be time well spent.

"Mouse letters" are easy to fill out (pencil and grease smudges accepted) and who knows but what it might even ease the conscience a little bit when a goof is made. We'll see to it that it is passed along so that maybe it won't be repeated again. No signatures or squadron identification on the letters please—we're not interested in "who" . . . only "why and how"!

Wrong Parts Replacement Can Lead to a Shorter Life

TECHNICAL publications are almost always written with a positive approach. The business of aircraft and engine maintenance and operation is a positive affair. There is little room for negativism except in limited cases of warnings and cautions where added emphasis is needed to prevent injury or damage. It is next to impossible to cover all contingencies when using the negative viewpoint, while accenting the positive is sure to provide the instructions required for fulfilling the necessary operations.

Engine maintenance, repair, and overhaul have been broken down into various subdivisions of responsibility to provide for the best and most economic restoration to serviceability. Publications have been written to cover these subdivisions of responsibility. Ordinarily, if positive instructions are not provided in a manual for a particular operation, it has been re-

served for a higher level of maintenance. One of the reasons that this is true is that to perform some of the operations, expensive special equipment and training is required in the performance. Even though on the surface the operations look simple enough, critical tolerances and adjustments may be destroyed by the uninitiated working without the special equipment.

An illustrative example has recently been brought to our attention. You no doubt will be able to think of others.

Unauthorized removal by other than overhaul personnel of accessory mounting adapters from transfer gearboxes of J79-2 and -8 engines has been indicated. These adapters are non-interchangeable from gearbox to gearbox except under certain conditions which can be controlled only by an overhaul facility. Correct machining, alignment, and shimming must be done to prevent excessive bearing and gear wear.

Technical publications, NavWeps 02B-105-AGA-502 and NavWeps 02B-105AGC-502, provide instructions for the only authorized and acceptable repairs for activities other than overhaul. If damage exceeds the limits set forth in these books, replace the complete gearbox rather than take a chance on more serious subsequent damage which could result from replacing precision-fitted parts.

Initiative is a great thing. Innovations have led to easier ways of doing things or to better products. Some control must be maintained, however, and your technical manuals have been designed to provide this control within reasonable bounds. Making adjustments or replacing parts which are not authorized can only lead to more complex problems. If the publication doesn't give specific instructions for an operation, assume that it is reserved for a higher maintenance level.—*GE Jet Service News*

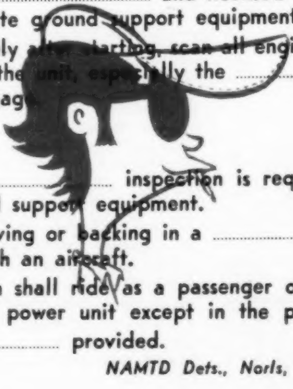
$3000 per Copy

THE overhaul program for NC-5 MEPPS has been suspended due to lack of funds. We have been paying up to $3000 per unit for overhaul charges.

A review of the work performed indicates that the majority of this work is within our capability at squadron, H&MS or MWSG level. This special support equipment is a TBA item belonging to the squadron and as such the responsibility for maintenance of these units belongs to the individual unit. H&MS and MARS maintenance officers.

Action must be taken at all levels to improve availability of these units so necessary to the accomplishment of the mission.—*2nd MAW*

MUGS SAFETY CROSSWORD



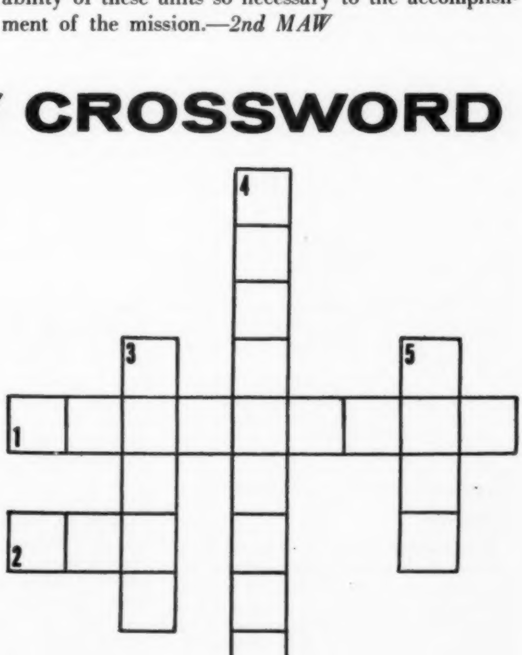
ACROSS

1. Only .... and licensed operators will operate ground support equipment.
2. Immediately after starting, scan all engine instruments on the unit, especially the .... pressure gage.

DOWN

3. A .... inspection is required for all ground support equipment.
4. Avoid driving or backing in a .... course with an aircraft.
5. No person shall ride as a passenger on a self-propelled power unit except in the permanent .... provided.

NAMTD Dets., Norls, San Diego



Answers: 1. Qualified 2. Oil 3. Daily 4. Collision 5. Seat

LETTERS TO APPROACH

Handy Dandy Inflation Cage

Washington—The December 1962 issue of APPROACH contained an interesting article by Captain Frank H. Bruce, Jr., USMC, entitled "A Look at the Tire Problem." This article described a portable tire inflation cage known as the Handy-Dandy Cage.

The cage appears to have merit and could probably be used to advantage should it be provided as a standard piece of ground support equipment to all Marine and Navy activities. It is also considered desirable to illustrate the use of this cage in a film entitled "High Pressure Gases in Aviation" to be produced in the Naval Air Station, Pensacola.

It is the understanding of the Bureau of Naval Weapons that several of these cages are available at the Headquarters and Maintenance Squadron 15.

It is requested that the Bureau of Naval Weapons be provided with a drawing of the subject cage. The drawing should be in sufficient detail so that the cages could be manufactured by an Overhaul and Repair Department. It is further requested that one of the cages be shipped immediately to the Receiving Officer, NAS, Pensacola, for use in film "High Pressure Gases in Aviation." The cage will be returned after completion of the film.

ROBERT C. CLARK
BY DIRECTION
CHIEF, BUWEPS

Inspection After A Hard Landing

Washington—Frequent reports have been received of damaged landing gear, supporting structure, and leading edge ribs in the wing. In each instance, the damage has been attributed to overload during landing of the A-4A, B, and C (A4D) airplanes. Certain airplanes fortuitously have been inspected prior to additional landings that would have resulted in major damage and possible serious injury to the pilot.

It is suspected that a number of landing accidents have occurred either because of damage previously incurred from a hard landing or from improper servicing of the struts. Both tests and analyses have confirmed that the design of the landing gear and structure is adequate for landings at the gross weight limits prescribed by the Flight Manual.

Since during PAR the frequency of damage because of hard landings does not correlate with the log book entries, it is presumed that inspections after a hard landing are not adequate and that hard landings are not reported unless damage is easily discernible. It is requested that after all suspected hard landings, the airplanes be inspected in greater detail for indications of deformation of skin, structure, and/or landing gear. Activities are requested to make recommendations as to how such inspections can be more effectively accomplished.

RAAD2411/551
BUWEPS

Bubble Trouble

NAS Alameda—Regarding your article "Bubble Trouble" page 34, APPROACH January, 1962 (Cuts and scribe lines resulting from improper technique in removal of spraylat protective coating). This is an old story. The volume of stuff, written and verbal, concerning proper procedure isn't getting through. Let's eliminate the condition as much as possible.

This type protective coating is used on both new and overhauled canopies. A suggestion has been submitted (number 1162-61) for the use of a pull string, tape or other device, placed on plexiglas canopies, windshields, windows, turrets, . . . , prior to spraylat application. When spraylat removal is desired, a pull on the loose end of the string or tape will tear the coating. This operation would be almost as simple as removing the cellophane from a pack of cigarettes.

Aero Engineering is investigating the idea. I think it's a good one. Maybe you can get the contractors to buy it.

E. O. KNOTT
Quality Control Group O&R

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Survival Training

Jacksonville, Fla.—When they talk about survival techniques, the student pilots of VA-44 speak with the authority of those who have been taught by one of the best instructors in the world.

The squadron, which readies attack plane pilots in the Atlantic Fleet for carrier duty, has acquired the volunteer services of Ross Allen, one of the world's foremost authorities on reptiles and an expert in the field of survival on land.

Allen, whose reptile institute is located in Silver Springs, Fla., teaches survival techniques to VA-44 pilots on a when-needed, when-can basis.

The pilots have learned to have respect for poisonous snakes, whereas before they were deathly afraid of them. They have also learned how to use simple techniques to protect themselves should they wind up in a snake-infested area.

VA-44 trains an average of 150 pilots each year and in the course of instruction they are required to fly over land-

A DELICATE DISH—All snakes are edible. John Street demonstrates the technique of skinning a rattlesnake as R. W. Tobias, AN, lends a hand with the microphone.

A SIMPLE DEVICE—The abundant cabbage palm could very well save the life of a man in the snake-infested sub-tropics. The shelled palm tied to the lower leg provides protection against snake-bite. Snakes almost always strike a man from the knee down.

ing areas which include the Okefenokee Swamp, in Georgia, and portions of Florida's vast Everglades.

These areas are teeming with at least six varieties of deadly poisonous snakes, plus man-eating alligators and other hazards. The instruction they are receiving from Ross Allen could very well save their lives should they be downed in these swamps and would definitely come in handy in other areas of the world.

LT. E. F. BRONSON
SURVIVAL TRAINING OFFICER

• This type training is excellent. See page 28 February Approach for another survival training program.

What's in it for me?

NAS Norfolk—Re: "What's In It For Me," Jan. issue I suggest that former optimist, now a realist look around some more.

Do the aviators you know who were promoted wear the wings with just pride and self respect—knowing that the new professional is more than a stick jock? He usually handles simultaneously several man-sized jobs, maintains his combat-readiness, "deserts" his family for months on end, follows when he'd rather lead (sometimes vice versa), "enjoys" non-union hours, etc.

He drives an aircraft for which he otherwise couldn't afford the gas. He's in an honored profession, among friends and associates without equal knowing that just anyone couldn't do his part in assuring our collective national and allied survival. He can also digest a box lunch and know damn well he's good whether there is enough room for promotion or not.

ANYMOUSE

Murphy's Get Around

NAS Norfolk—Have long read your Murphy column. Hope that designers are getting the word—a pilot's faith and luck can go just so far these days.

NAME WITHHELD

ELIMINATE 'MURPHYS'!

• Every effort is made to circularize manufacturer's design departments. Judging by the mail many are reading it regularly. Future plans are to forward each new Murphy by official letter to design team involved. Note the poster of General Dynamics Design Safety Staff at Fort Worth, reproduced herewith —

Amplification of Murphy

Santa Ana, Calif.—Your article on pg 44 of the September issue was an excellent Murphy and offered a good solution; however, if Anymouse had looked further he would have found that the other end of the hoses are set up for almost the same situation of hoses "A" connected to inlet "B" etc., on the outboard droop manifold. Our squadron has instituted the following solution:

Paint both ends of hoses same color code, with a different color for each hose. Color code the airframe itself near connecting points for ready reference. This is followed by a Quality Control inspection on run-up to visually check for proper operation and rigging.

A better solution would be the use of different fittings on the outboard droop manifold to avoid confusing the four hoses. Such fittings are in use on all other droop actuating manifold except the outboard droop.

D. R. GALISTEL, CPL
VMF-334

RCVG-12 and Its Big Picture

NAS Miramar—RCVG-12 commenced Fleet Replacement Enlisted Maintenance Training (FREM) in April 1958. During the month of October 1962, the 10,000th "FREM" trainee graduated from this training. The squadrons providing this training are: VF-121 at NAS Miramar (*Phantom II/Demon*), VA-122 at NAS Moffett Field (*Skyraider*), HATron-123 at NAS Whidbey Island (*Skywarrior*), VF-124 at NAS Miramar (*Crusader*) and VA-125 at NAS Lemoore (*Skyhawk*).

These squadrons have played a very important part in furnishing the Pacific Fleet attack carrier squadrons with trained maintenance personnel, thereby increasing the Fleet's readiness. The Naval Air Maintenance Training Detachments assist in training "FREM" personnel by providing formal classroom training. Personnel then receive on-the-job training in the appropriate Replacement Air Group Squadron.

SIO

NavWeps 00-75-510

approach

THE NAVAL AVIATION SAFETY REVIEW

VOL. 8 NO. 9*

Purposes and policies: *Approach*, published monthly by the U. S. Naval Aviation Safety Center, is distributed to naval aeronautical organizations on the basis of 1 copy per 10 persons. It presents the most accurate information currently available on the subject of aviation accident prevention. Contents should not be considered as regulations, orders, or directives. Material extracted from mishap reports may not be construed as incriminating under Art. 31, UCMJ. **Photos:** Official Navy or as credited. Non-naval activities are requested to contact NASC prior to reprinting *Approach* material. **Correspondence:** Contributions are welcome as are comments and criticisms. Views expressed in guest-written articles are not necessarily those of NASC. Requests for distribution changes should be directed to NASC, NAS Norfolk 11, Va. Att: Safety Education Dept., if you are receiving the magazine free because of military or commercial contract status with the Navy. . . . IF YOU ARE A PAID SUBSCRIBER, address all renewals and change of addresses to Superintendent of Documents, Washington 25, D. C. **Subscriptions:** Single copy 35 cents; 1-year subscriptions $3.50; 2 yrs., $7.00; 3 yrs., $10.50; $1.00 additional annually for foreign mailing. **Printing:** Issuance of this publication approved by the Secretary of the Navy on 15 April 1961. Library of Congress Catalog No. 57—60020.

PHOTO AND ART CREDITS:
Cover Photo: J. Campoy, Courtesy McDonnell Aircraft Corp.
IFC: McDonnel Aircraft Corp.
20: Aging Pilot Charts, Courtesy Flight Safety Foundation, Inc.
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by Don Stuck

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Inside Back Cover Lift & Drag

*The issue number in the February issue should have read number 8.

Our product is safety, our process is education, and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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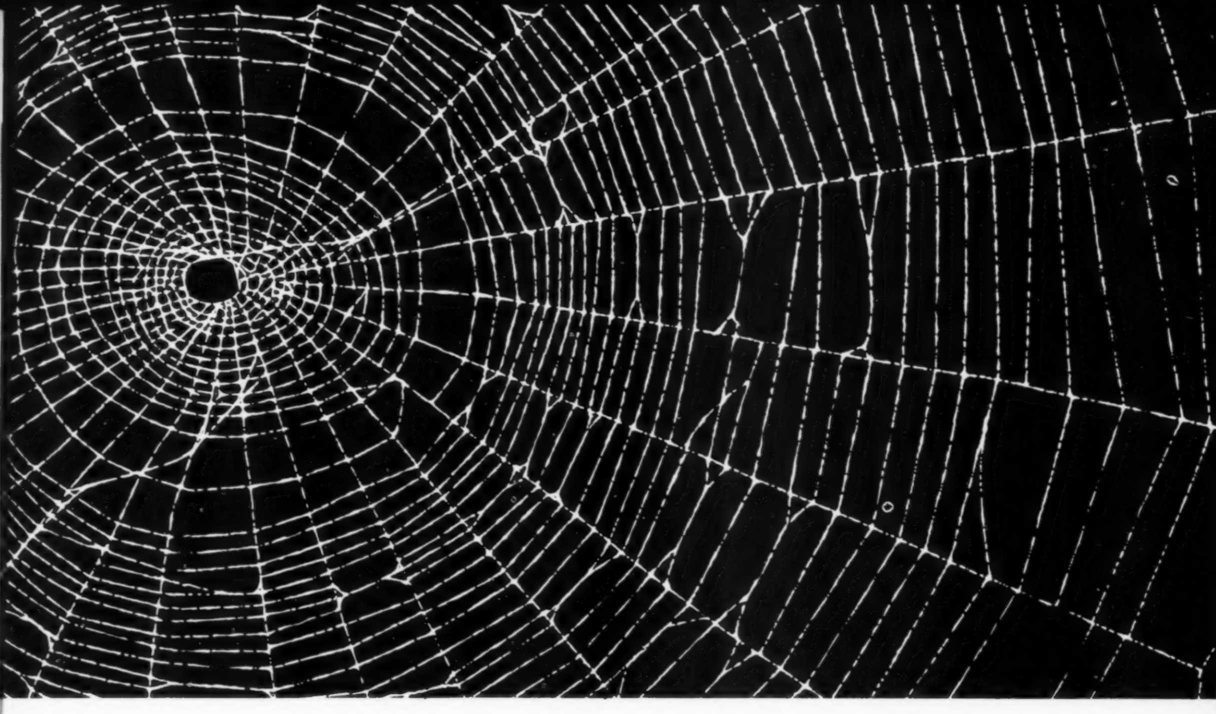

A THREAD AT A TIME . . . YOU HARDLY NOTICE

Hazards that beset air operations often mount up, a thread at a time. One by one these are hardly noticed—yet they can combine into an accident—if enough good men do nothing to report one by one the problems, failures, incidents and situations that weave the web of trouble.

REPORT AN INCIDENT TODAY—PREVENT AN ACCIDENT TOMORROW

If the mishap is not reportable under the provisions of the current OpNav Inst 3750.6, but may contribute to preventing an accident, incident, hazard or injury, send an Anymouse Report to the Naval Aviation Safety Center. Forms are available at any naval aeronautical unit.

LIFT and DRAG

Carrier decks are dangerous areas, but they can be kept from becoming more dangerous than they inherently are. One important part of a safety program is a vigorously prosecuted indoctrination program for men being introduced to flight operations for the first time. This must include air group personnel.

Initially and after long layoffs the training of crews must be done slowly and safely. The tempo will speed up naturally, and safely as confidence grows. Make haste slowly, using proven principles and procedures.

The real solution is good men, good training, good supervision—and lots of hard work.